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STANDARD OIL COMPANY (INDIANA)

AUTOMOTIVE INDUSTRIES

THE AUTOMOBILE

Volume 84

Number 3

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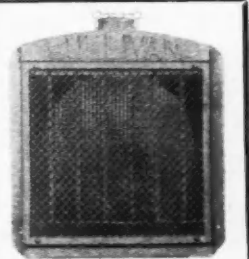
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February 1, 1941

Production Increased **30%**



(Above) **ELECTRIC MOTOR SHAFT** rough and finish turned at 45 pieces an hour using Transultex.

(Left) **TWO P. & W. AUTOMATIC LATHES** in plant of Williams Oil-O-Matic Heating Corp., Bloomington, Ill. Tool-life up 50% since using Texaco Transultex Cutting Oil.

(Lower left) **CLOSE-UP** of tungsten-carbide Tool cooled by Texaco Transultex Cutting Oil.

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- ★ More scheduled airline mileage within the U.S. and to other countries is flown with Texaco than with any other brand.
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- ★ More stationary Diesel horsepower in the U.S. is lubricated with Texaco than with any other brand.
- ★ More Diesel horsepower on streamlined trains in the U.S. is lubricated with Texaco than with all other brands combined.
- ★ More railroad rolling equipment in the U.S. is lubricated with Texaco than with any other brand.

ELECTRIC MOTOR SHAFTS, $\frac{7}{8}$ " x $12\frac{1}{4}$ ", No. 1045 steel, rough and finish turned on 2 Pratt & Whitney Automatic Lathes. Spindle speed 750 r.p.m. Surface speed 165 ft. per minute.

The production of 45 pieces an hour is an increase of 30%. Finish is better than formerly. Life of the tungsten-carbide tool is up 50%.

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AND METAL-CUTTING COOLANTS

February 1, 1941

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IN THIS ISSUE . . .

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

Volume 84 February 1, 1941 Number 3

New Projects Undertaken By Cutting Fluids Committee

According to an announcement by Joseph Geschelin, chairman, the Independent Research Committee on Cutting Fluids has been functioning for a period of almost four years and during this period has cooperated with the American Society for Metals and the S.A.E. in the publication of its technical reports. One of its latest reports entitled, "A New Study of Cutting Fluid Recommendations" by Moir and Boston, which was presented at the S.A.E. National Production Meeting in Hartford in May, 1940, deals with an approach to problems of machinability.

Two fundamental projects are the subject of investigation for the current year. The first of these is concerned with the production of a standardized "reference" material to be used by investigators in the field of metal cutting. The second deals with the simplification of types of cutting fluids used in industry and aims at the standardization of nomenclature by defining the character of the widely used cutting fluids.

The Committee is cooperating with the Industrial Division of the U.S.A. Ordnance Department and will be glad to confer with any organization which can take advantage of the specialized facilities of the group in connection with problems of metal cutting in the National Defense Program. Inquiries should be addressed to the chairman.

The following is a list of the personnel of the Committee for 1941:

Prof. O. W. Boston, University of Michigan; H. M. Fearon, Standard Oil Co. of New Jersey; C. L. Foreman, assistant metallurgical engineer, Buick Motor Div.; Floyd Fritts, Standard Oil Co.; C. B. Harding, cutting oil engineer, Sun Oil Co.; Dr. Raymond Haskell, The Texas Co.; E. J. Hergenrother, The International Nickel Co.; W. D. Huffman, chief chemist, Chevrolet-Forge; W. H. Kildow, Shell Petroleum Co.; H. E. Martin, E. F. Houghton & Co.; B. B. Mears, Petroleum Advisers; H. L. Moir, Mechanical Research Dept., Pure Oil Co.; W. H. Oldacre, director research and engineering, D. A. Stuart & Co.; M. W. Reynolds, Acheson-Colloids Corp.; E. M. Slaughter, Republic Steel Corp.; G. L. Sumner, Westinghouse Electric & Mfg. Co.; Joseph Geschelin, Chilton Company.

GENERAL

The Essentiality of the Automobile Accentuated by Defense Demands

Page

103

Just how all this effort that is being made for defense will affect automobile production in the months to come is a question of real moment right now. Will all facilities be diverted to making war implements? Will we be able to continually buy new cars as and when we want? Read the future in this article.

PRODUCTION

Nash Realigned Plant Facilities for '41 Models

104

In this, the fifty-seventh, of the monthly articles on production methods and layouts in the principal automotive plants of the country, the author takes us through the Nash plant showing the changes that were made in routine and equipment. Plant routings of the parts and the machining are all shown.

MARINE ENGINES

At the Motor Boat Show

116

Several new types of marine engines have been presented for public favor at the annual show. Some of these have new engineering features that should interest you.

DIESEL

New Ideas in the Field of Diesel Engine Instrumentation

120

At the recent SAE annual meeting several new ideas were presented in the Diesel field. Here a few of them are presented. The ideas of today may be the practice of tomorrow, so keep up to date by reading these abstracts.

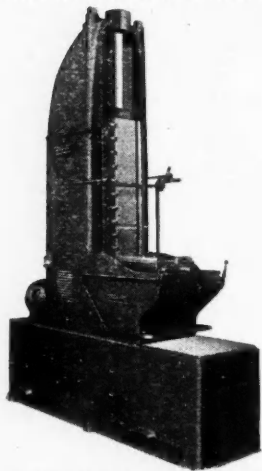
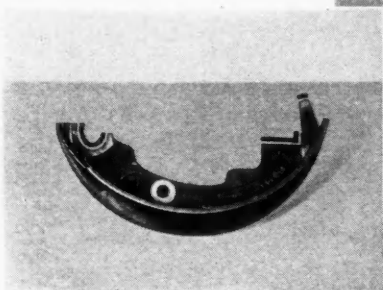
CONTROL LAYOUT

Statistical Method of Quality Control

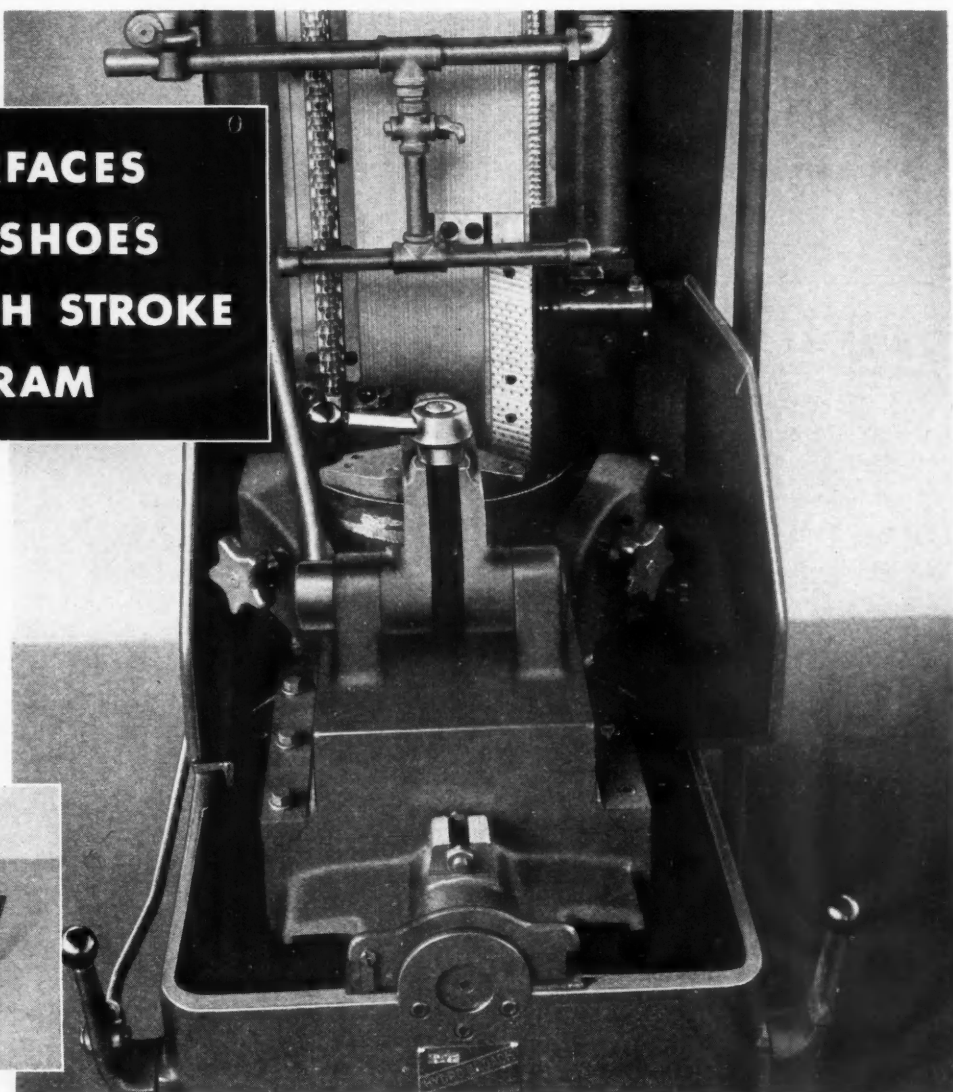
128

Here is a subject that has been discussed a great deal in recent years. Much has been done to develop the technique. It is time for it to come into its own in a big way. This article is a material contribution to the understanding of it. Read it, therefore, with the idea that here is indeed a new tool of efficiency in the movement for more production with even a higher degree of accuracy.

**THREE SURFACES
OF BRAKE SHOES
BROACHED EACH STROKE
OF THE RAM**



• CINCINNATI Single Ram Vertical Hydro-Broach Machine.



THE brake shoe illustrated above presented several problems in broaching. First of all, the part is relatively thin for such a width of broached surface — it totals approximately $5\frac{3}{4}$ ". Secondly, there are three surfaces, about as far apart as they can be for the size of the shoe. Then, too, accuracy requirements are rather close and related to each other. All these conditions are successfully met with the machine illustrated above—a CINCINNATI No. 5-54 Single Ram Hydro-Broach having receding table, and equipped with a rigid hand clamped fixture.

These brake shoes are broached to a smooth finish, and without distortion, at the rate of 123 per hour. (Broached surfaces indicated by the heavy lines.)

There are several features of the CINCINNATI Hydro-Broach line responsible for the smooth performance and high production rates which may be obtained. Hardened ways, automatically lubricated . . . sturdy column and fixed knee construction . . . safe operating controls. Complete description and specifications in catalogs M-886 (Single Ram Machines) and M-894 (Duplex Machines). Write for your copies today.

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February 1, 1941

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Published on the 1st
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February 1, 1941

The Essentiality of the

Automobile Accentuated by Defense Demands

Manufacture and Use of Motor Vehicles Important in Meeting Our Present Needs

SOME critics of industry in the present national defense emergency believe that to achieve rearmament quickly and efficiently the production of certain goods should be curtailed in order to give the green light to Army and Navy orders. Among such goods are transport planes for the commercial airlines and passenger car models of automobiles. Although the demand for aircraft for military purpose is extremely urgent, the airlines probably have a point in seeking to maintain their equipment so that they can provide fast and reliable transportation for business executives on defense work.

With respect to the manufacture of passenger cars it can be said that it is not hampering defense work and is not likely to do so unless and until there is a definite shortage of raw materials or manpower. When that time comes, the motor car manufacturers will be ready and willing to curtail production in the interests of national defense. They pledged themselves to do so in an A.M.A. resolution last Oct. 15.

Inasmuch as it is rather generally understood that less than 10 per cent of an automobile plant's equipment can be used in the manufacture of airplanes, tanks or other munitions, there appears no immediate reason for curtailing passenger car output. This is particularly true since the automobile industry already is at work on more than \$1,000,000,000 of defense orders as its share in the current emergency.

What some of those who are even mildly critical of "business as usual" fail to appreciate is the dislocation in our economy that would result from any drastic curtailment of passenger car production. Pointing out for one thing, that a year is necessary between the inception of a defense project and production, Alfred P. Sloan, Jr., board chairman of General Motors Corp., recently had some pertinent facts to offer on the subject.

"I want to emphasize the point that nothing can be gained . . . should we curtail the production of things incident to our normal needs for the sake of accelerating the production of materials incident to defense until such production is being delayed by peace-time needs. There is little now with which to accelerate. Watchful waiting would be the result. Millions, directly and indirectly, would be thrown out of work temporarily. The forces within the economy would become unstabilized . . . It seems clear, therefore, that there is not in sight the absorption of our full productive effort in terms of the maximum capacity of men, materials and capital."

Mr. Sloan's remarks are buttressed by the fact that motor transport employs one-seventh of all U. S. workers, or 6,500,000 men and women. A total of 443,000 employees are engaged in the manufacture of motor vehicle parts and equipment. A partial shut-down of passenger car manufacture would throw many of these out of work because it would be impossible to transfer them immediately to defense activity. It also would be a severe handicap to the 39,000 new car dealers in the United States and their many more thousands of employees.

The motor car industry is the largest consumer of many commodities, using 18 per cent of the steel, 80 per cent of the rubber, 75 per cent of the plate glass, 23 per cent of the nickel and 34 per cent of the lead consumed in this country. Of course, national defense priorities may necessitate cutting the consumption of some of these raw materials. But arbitrarily curtailing motor car output also would reduce employment in some industries not vital to national defense.

(Turn to page 139, please)

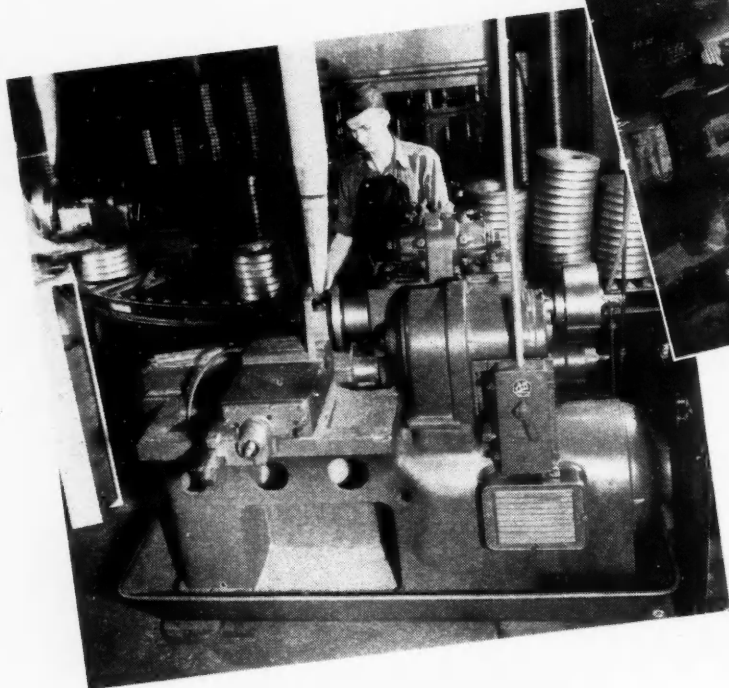
NASH Realined Plant

LAST FALL when George W. Mason, president of the Nash-Kelvinator Corp., announced a new Nash car—the Nash Ambassador 600—designed to compete with the lowest priced cars in the industry, few people outside of his own associates could have visualized the solid foundation upon which this challenge was based.

For here was a car new in specification detail, fresh and distinctive in design, marking the first production example of a modified Lancia front end independent suspension system, and a new six-cylinder engine. Moreover, it featured a unitized body structure in which body and frame are an integral unit possessing great strength and rigidity, although lighter by 400 lb. when compared with conventional construction.

Now that we have had an opportunity to survey personally the changes wrought in the Nash Motors

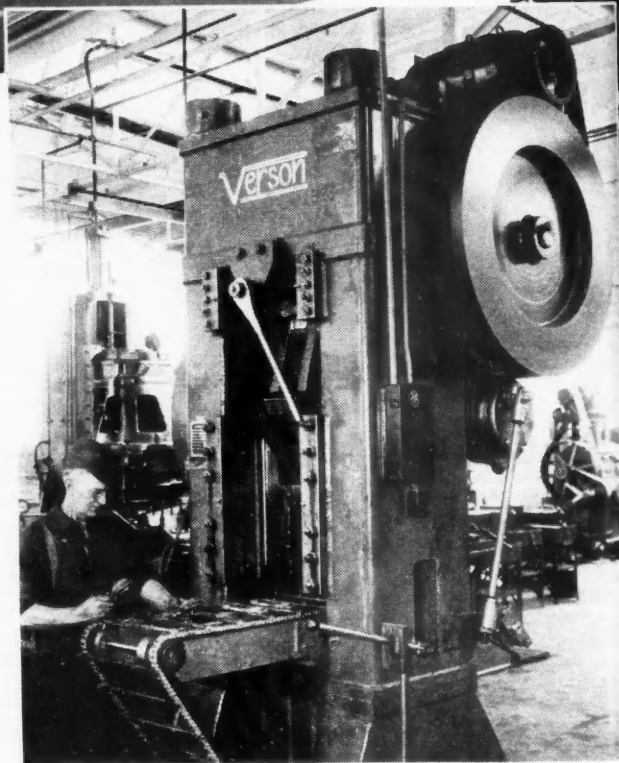
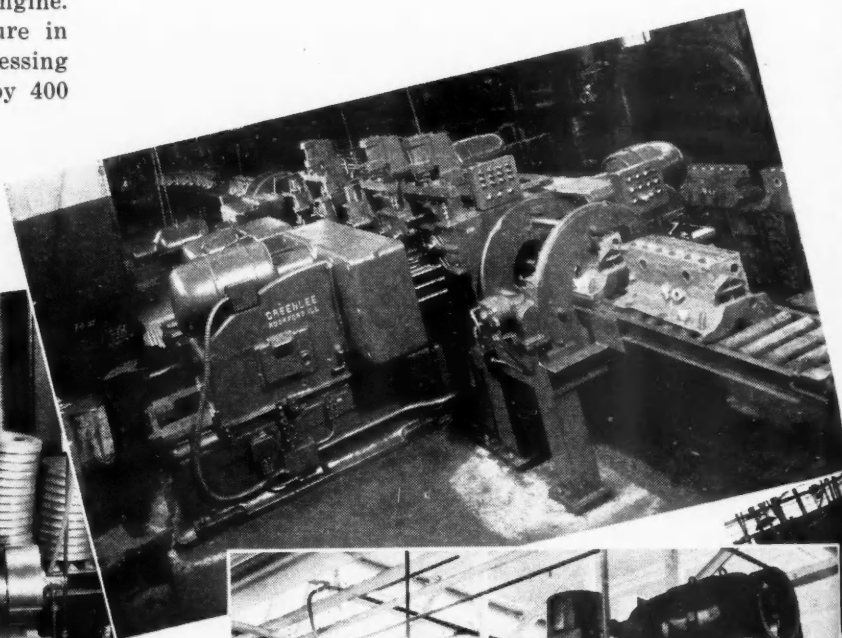
Division in Kenosha and in the Seaman body plant in Milwaukee, we can appreciate how wisely the \$7,000,000 appropriation for modernization was administered, and how sound is the foundation for producing the 1941 line of Nash cars. It may be noted briefly that preparation for the new models comprehended a complete realignment of plant facilities, the addition of a new wing for the engine plant, introduction of the most modern machine motor shops to be found any-



(Above) Action shot of third and fourth operations on the Nash "600" flywheels, performed on Gisholt No. 12 Hydraulic Automatic Lathes.

(Upper right) One of the new tunnel-type Greenlee machines on the L-head motor line, this nine station machine handling the drilling and tapping of top and bottom faces. Note the automatic roll-over fixture at the left, and the tell-tale signal lights on the panels in the background.

(Right) Verson All-Steel press heads the new connecting rod line for the six-cylinder L-head engine, coining the rod forgings before machining. Note the chain conveyor fixture which carries the forgings under the ram.



Facilities for '41 Models



Finished cars approaching the end of the final assembly line in Kenosha

1,000,000 sq. ft. In addition to the marvelous machine lines evident in the major departments, complete mechanization has been extended to the materials handling system. Eleven and a half miles of power driven

conveyors have been provided for materials handling and for processing; two and a half miles of conveyor lines have been installed for assembly and sub-assembly operations.

Needless to say, the complete story of what has been accomplished at Nash would be quite beyond the scope of this article. For this reason, we have focused our attention on the major details of the manufacture of the low-priced car, although even this sampling constitutes a sizable problem.

Norton grinder with cam-grinding attachment for contour grinding of pistons.

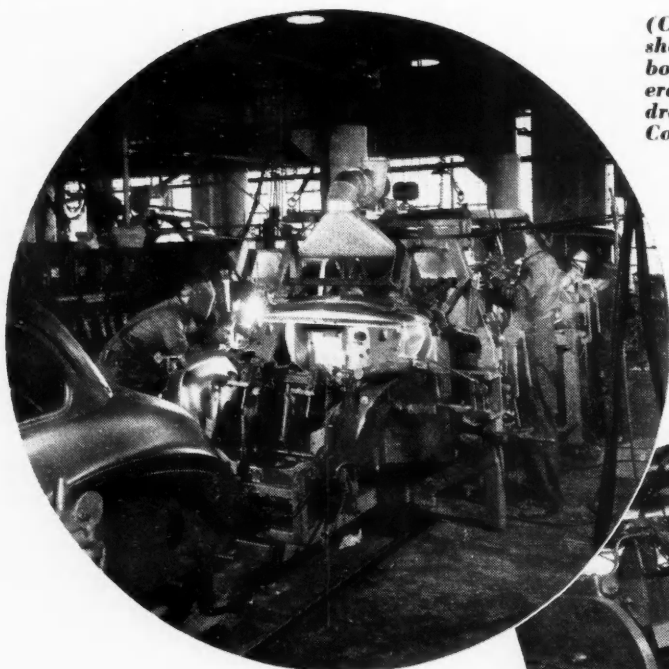
where in the industry at this writing.

As a matter of interest, we refer the reader to an earlier article on the Nash plant (AUTOMOTIVE INDUSTRIES, Jan. 2, 1937), when all of the manufacturing operations except for bodies were consolidated in Kenosha. A direct comparison between the older set-up and the one described here will be appreciated by factory executives close to the dynamic picture of progress in the art of mass production.

At the present writing the Kenosha plant boasts 1,800,000 sq. ft. of productive floor space; Milwaukee,

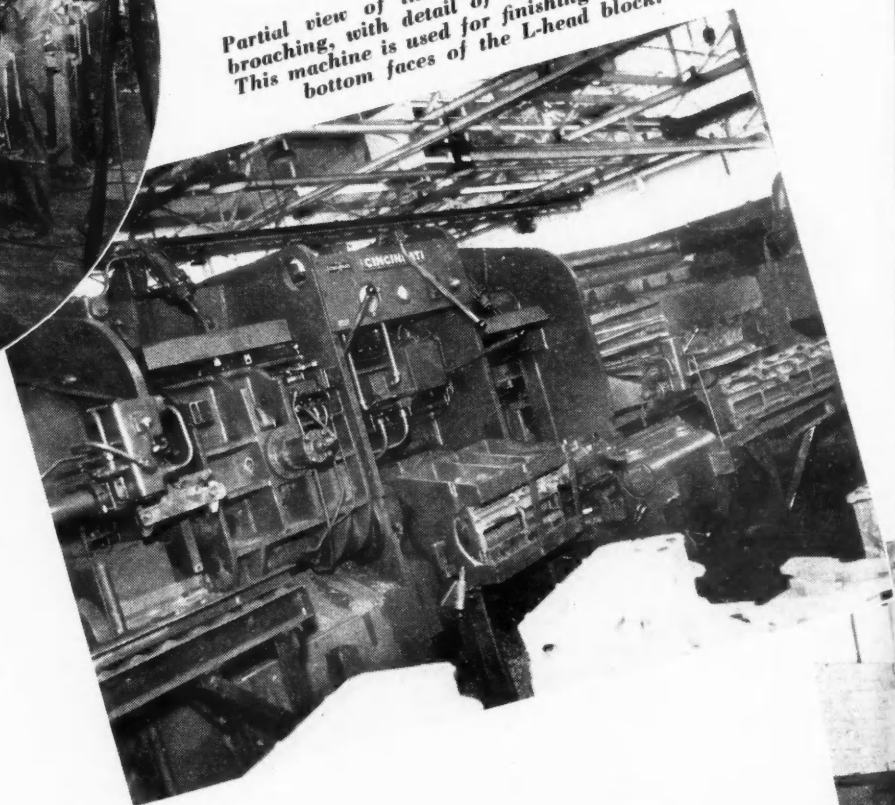
*This is the Fifty-seventh
in the series of monthly
production features*

PRODUCTION



(Circle) The eight-man crew on the steel top station shown at work on the arc-welding of the top to the body structure. Power for all of the arc-welding operations on the two merry-go-round assembly lines is drawn from a battery of 150-amp. Lincoln Electric Co. welding machines on the fourth floor, directly below the assembly lines.

Partial view of the huge Cincinnati surface broaching, with detail of the loading fixture. This machine is used for finishing the top and bottom faces of the L-head block.



Consider now a quick cross-section of high spots evident in a conducted tour through the main departments. To any one familiar with the earlier plant arrangement, the most striking change is found in the motor machine shop, now augmented in area by the addition of a modern building section. Incidentally, the new addition is flooded with daylight by fluorescent lighting. The cylinder block machine line marks an integration of some of the most advanced items of equipment known to the art. Here are the huge Cincinnati surface broaching machines—an outstanding automatic line-up of Greenlee operations developed from the first installation of this character, described in *AUTOMOTIVE INDUSTRIES*, Dec. 1, 1940—Natco and Ingersoll machines—Baker single-spindle cylinder reaming machines—most advanced examples of hydraulically actuated Micromatic honing equipment—gravity roller conveyor system by Matthews with automatic roll-over fixtures.

Machining of the one-piece rod on one of the most advanced lines in the industry—compact piston line—new crankshaft department sparkling with unusual items such as the Gisholt Dynetric balancer and the Landis hydraulic grinders including the new five-wheel machine.

Interest centers in the fabrication and assembly of the front end suspension. Here will be found the machining and centerless grinding of the long king-pins—machining and internal honing of the big sleeve—marvelous brain unit for the automatic inspection of the bearing rollers.

The new rear axle department sparkles with such details as the Rotoshaver on the differential case—special Ex-Cell-O machines—Cincinnati centerless grinding of the taper end of the axle shaft—Gleason Revacycle, cutting differential side gears—Conomatic,

turning differential gear blanks, burnishing the hole and convex bearing surface in same setting.

First major change in final assembly procedures since the introduction of the Lincoln-Zephyr is found in the assembly line for the new low-priced car. This has been worked most ingeniously to take advantage of the unitized body design, as will be evident later. A study made by the plant engineering department reveals that only 12.5 ft. of final assembly conveyor space is used per car. They find that this represents the most intensive space utilization in the industry.

Shifting for the moment to Milwaukee to the Seaman Body plant, we find revolutionary changes due to the fundamental changes in body structure. Here is an unusual welding line for the one-piece underbody and frame unit—unique oval assembly lines for body assembly, employing Progressive welding guns and Lincoln Electric arc welding equipment—unusual paint shop layout with continuous conveyor system controlled by a special Mechanical Handling Systems DC drive with fluid couplings.

These are just glimpses, flashes of fine achievement which we shall picture more in detail in a moment. In the sections which follow, we shall describe the major activity in each of a number of basic departments, supplementing the word picture with reproductions of

Factory Routing for Connecting Rod and Cap

OPERATION AND EQUIPMENT

COIN

Verson No. 400 KT steel single crank, single action—single gear, single drive press

BROACH large end and bolt bosses

Cincinnati No. 5-42 duplex vertical broach

DRILL and REAM piston pin hole—drill oval

Greenlee 1-way vertical rear column three station hand index drill-ream and elliptical bore machine

CHAMFER large end—one side

20-inch Barnes Drill Company drill

CHAMFER pin hole both sides

Nash double end machine

CUT apart

Cincinnati 5/54 vertical duplex hydro-broaching machine

FINISH BROACH joint face of rod

Cincinnati 1/24 vertical duplex hydro-broaching machine

DRILL, REAM and CHAMFER bolt holes

Greenlee one-way horizontal hydraulic feed five-station hand index multiple spindle drill and ream machine

CHAMFER bolt holes

Single-spindle Leland-Gifford machine

DRILL—squirt holes

Kingsbury special 3-spindle drilling machine

MILL spots on small end

Bilton hand milling machine

FINISH BROACH joint face of cap

Cincinnati 1/24 vertical duplex hydro broaching machine

OPERATION AND EQUIPMENT

DRILL, REAM and CHAMFER bolt holes

Greenlee one-way horizontal hydraulic feed five-station hand index multiple spindle drill and reaming machine

CHAMFER bolt holes

Single-spindle Henry & Wright

MILL bearing notches

No. 1-14 Kent-Owens hydraulic milling machine

FINISH GRIND joint face

Porter cable type 5-15 in. horizontal disk grinder

PRESS in bushing and burnish

No. 6 Toledo punch press

GUN DRILL rods

Leland-Gifford 2-4-spindle, 2-6-spindle drill presses

BURR oil hole

Bench

GRIND joint face of rod

Porter cable type 5-15 in. horizontal disk grinder

WASH

MILL bearing notches

No. 1-14 Kent-Owens hydraulic milling machine

PRESS in bolts

Flexible power press

ASSEMBLE cap and tighten

Rotary table

GRIND sides of rod

No. 36-A Hanchett rotary surface grinder

SEMI-FINISH bore, CHAMFER both sides large end

Davis-Thompson machine

BROACH large hole

Oilgear horizontal XL-12 broach

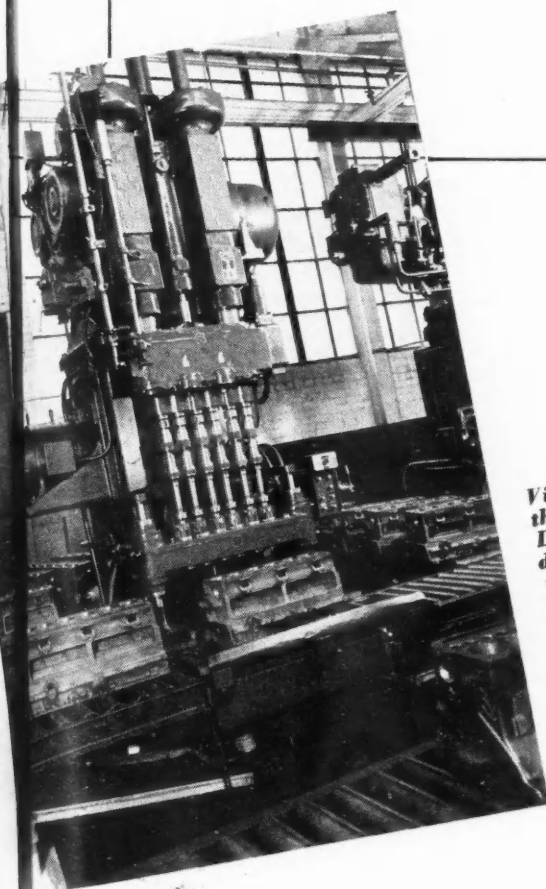
HONE large end to size

305-R-Barnes Drill Company single-spindle hydraulically reciprocated honing machine

CHECK and STRAIGHTEN

FINISH BORE pin hole

Heald No. 49 double end precision Borematic machine



View of one of the two Barnes Drill Co. hydraulic honing machines with Micromatic hones on the six-cylinder motor line.

a selected group of official factory routings, affording further visualization of the whole operation by means of a pictorial section.

The master mechanic's department points proudly to the extensive use of power clamping on many major items of new production equipment. This is a forward looking step in the direction of eliminating fatigue on

the part of the operators.

Before going into the details of manufacturing departments, a word concerning the task of plant re-arrangement which is now an accomplished fact. In effect, the facilities in Kenosha were completely uprooted and then re-arranged according to the new pattern. The motor department is but one example. The new six-cylinder engine line with its new equipment is a straight line, interconnected by the gravity roller conveyor, terminating at the start of the new motor assembly line. The larger blocks are machined in the same department but on separate parallel machine lines, communicating with separate final assembly lines.

The final car assembly building, too, was completely re-arranged to fit a new pattern. Here is a unique assembly line for the low-priced car, a separate line for the bigger cars, as will be described later.

Engine Department

We shall confine this discussion to the high spots of the manufacture of the new six-cylinder L-head engine, starting first with the machining of the block. The cylinder block line consists of a single straight-through line-up of equipment, completely interconnected by the Matthews gravity roller conveyor system with automatically controlled roll-over and elevating fixtures. The sequence of operations as well as the details of the machinery in the line will be found in the routing reproduced elsewhere in the article. The line is served by a continuous chip con-

Factory Routing of Crankshaft

OPERATION AND EQUIPMENT

MILL locating spots
Sundstrand No. 25 Rigidmill

ROUGH TURN all line bearings—**STUB** and **FLANGE** ends
LeBlond 7-ACL automatic crankshaft lathe

FINISH TURN all line bearings—**STUB** and **FLANGE** end
LeBlond Type DM-4 station continuous production—crankshaft lathe

FACE all cheeks down to pins
LeBlond 6-AC automatic crankshaft lathe—2-spindle

ROUGH and **FINISH TURN** all pins
LeBlond type 6-AC double spindle crankshaft lathe

DRILL $\frac{1}{4}$ oil holes and **BURR**
Leland-Gifford drill presses

STRAIGHTEN and **INSPECT** clean centers
Flexible power press

FINISH GRIND No. 1-2-3-4 main bearings. Oil slinger and pulley diameter
Landis 16 x 40 in. 1W 5-wheel hydraulic grinding machine

FINISH GRIND gear, **FIT** and **FACE** thrust shoulder and No. 1 main bearing to length
Landis grinder

OPERATION AND EQUIPMENT

FINISH GRIND flywheel, **FIT** and **FACE** of flange
Landis 10 x 36 in. type C grinding machine

FINISH GRIND 6-pins
Landis 16/32 in. type D hydraulic crank pin grinding machine

DRILL and **TAP** flange drill, **BORE** and **REAM** pilot hole.
DRILL and **TAP** front end and **FACE** to length, **DRIVE IN** bushing
Nateco 6-station 2-way horizontal combination drilling, reaming and tapping machine

DRIVE IN bushings

CUT keyways and **STRAIGHTEN**
Kent-Owens No. IV hydraulic milling machine
Flexible power press

WASH

LAP all bearings
Schrader Model B hydraulic automatic crankshaft lathe

STRAIGHTEN
Flexible power press

WASH

INSPECT

veyor built into a tunnel in the floor, communicating with every machine.

Operations begin with the delivery of cylinder block castings from the adjacent foundry building, the blocks coming in through a tunnel. First major operation is that of broaching the top, pan rail, bearing lock, and half bore on a special horizontal Cincinnati hydraulic surface broaching machine. The input power for this machine is 166½ hp.; maximum stock removal of the order of 3/16 in.; ram travel of 14.5 ft.

This equipment consists of a double acting horizontal slide broaching machine, a pair of cradle type power operated fixtures, the first holding one piece in position for broaching the bottom, the second for the top, and a power-operated turnover mechanism built into a section of the conveyor between the two fixtures. The broach ram carries four sets of tools, one set for finishing the bottom with one pass, while broaching in one direction; the other sets of tools arranged to broach in the opposite direction.

The cradle type fixtures are alternatively moved into and out of the broaching position in proper relation to the ram movements so that the operation is continuous. One piece is removed and replaced at one fixture while the piece in the other fixture is being broached.

The transferring of the work from the conveyor into and out of the fixture and transfer device and onto the exit conveyor is all done by power using hydraulic pressure, hand controlled.

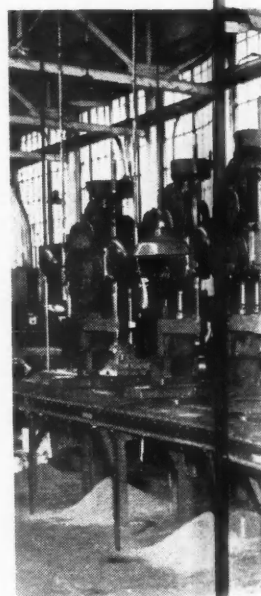
Among the outstanding features of this machine are: hydraulic clamping of the work, each work-holding cradle having two hydraulic cylinders actuating the cam locating clamps; broach inserts of "thick chip" type, with "Rotor-Kut" inserts for rough-broaching the half-bores. Unique feature of the three Cincinnati broaching machines in the engine department is the automatic "scanning" device which stops the machine if excess stock exceeds the normal value.

In effect the scanning device consists of a brass template so adjusted as to be 3/16 in. away from the finished dimension. As the ram progresses across the work, the template feels along the rough face and if, at any point, the excess stock exceeds 3/16 in., the template makes contact with the casting. In this event, an electrical contact is made with a trolley through a wire connection, this in turn communicating with a limit switch, thence to the main control valve which can stop the machine at that instant.

On all three machines, the hydraulic system is equipped with an hydraulic safety valve which by-passes the delivery oil when the pressure required to overcome the resistance of the ram becomes excessive. Despite the tremendous size of the equipment and the inertia of the huge rams, the hydraulic control system will stop ram movement accurately within 1/8 in.

The second of the Cincinnati surface broaching machines on the motor line is used for broaching the manifold pads and valve cover face. It has a ram travel of 13.5 ft.

Greenlee has provided three marvelous tunnel type automatic machines which contribute materially to the smoothness and perfection characteristics of the performance of the motor block line. Each of the machines has its every function protected by an intricate system of electric interlocks and is equipped with a system of tell-tale lights which aid in locating the source of trouble when a machine may shut down due to tool breakage or to mis-alignment of the work or due to some other cause.



Typical of the Greenlee equipment is the nine-station horizontal automatic transfer type machine arranged to drill, chamfer, and tap all holes in the top and bottom surfaces of the block. In addition, at station five the machine also straddle mills the main bearings and mills the bearing lock notches. The sequence of operations is as follows:

Station No. 1—Load and turn on side.
 Station No. 2—L.H. Head (top) 22—"U" (0.368) drill for 7/16 in.—14 tap; R.H. Head (bottom) 20—"F" (0.257) drill for 5/16 in.—18 tap; 1—5/16 in. drill for 3/8 in.—16 tap; 1—3/16 in. drill; 1—7/16 in. drill; 8—chamfer for 7/16 in.—14 tap.
 Station No. 3—22—chamfer for 7/16 in.—14 tap.
 Station No. 4—Idle.
 Station No. 5—15—1/4 in. drill—Mill bearing lock slots and straddle mill main bearings (10 cutters and 1 arbor).
 Station No. 6—Idle.
 Station No. 7—22—7/16 in.—14 tap; 8—7/16 in.—14 tap; 1—3/8 in.—16 tap; 20—5/16 in.—18 tap.
 Station No. 8—Idle.
 Station No. 9—Turn over on bottom.

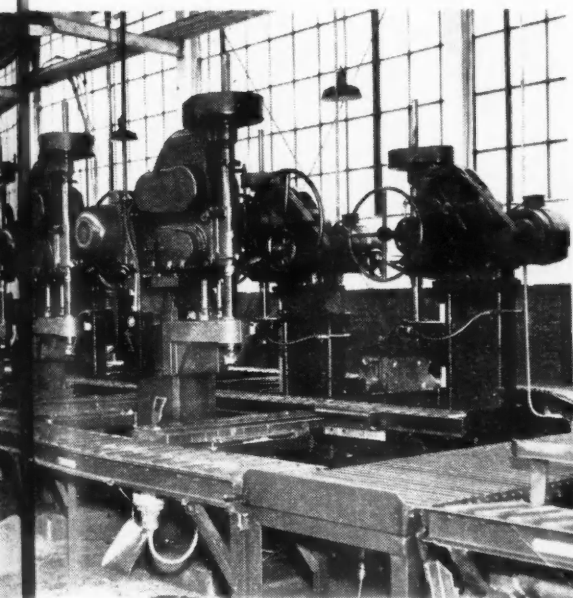
There are two nine-station Greenlees in the line, supplemented by a still larger machine—a twelve-station angular and horizontal automatic transfer drilling and tapping machine for operations on the pump and distributor holes and the two sides of the block.

Exceptional care is taken to assure finely finished cylinder bores. As will be noted on the routing, the bores are first rough- and semi-finish bored on a big Foote-Burt seven-station, 42-spindle hydraulic feed drilling and boring machine, using Carbide-tipped bladed cutters. Following a number of subsequent operations, the cylinder bores are finish-reamed, this time individually, on a battery of eight single-spindle No. 217 Baker drills. This final operation is performed with Barber-Colman special HSS inserted spiral stagger blade reamers.

Final operations on the cylinder bores constitute a rough- and finish-honing on two No. 214 Barnes Drill Co. multiple-spindle hydraulic honing machines fitted with Micromatic hydraulic honing tools. The Barnes honing machines embody a new development comprising positively controlled uniform increments of feed-out of the abrasive members in the hone. This principle is intended to provide faster cutting action, longer stone life, cooler operation, more uniform size control, and finer surface finish.

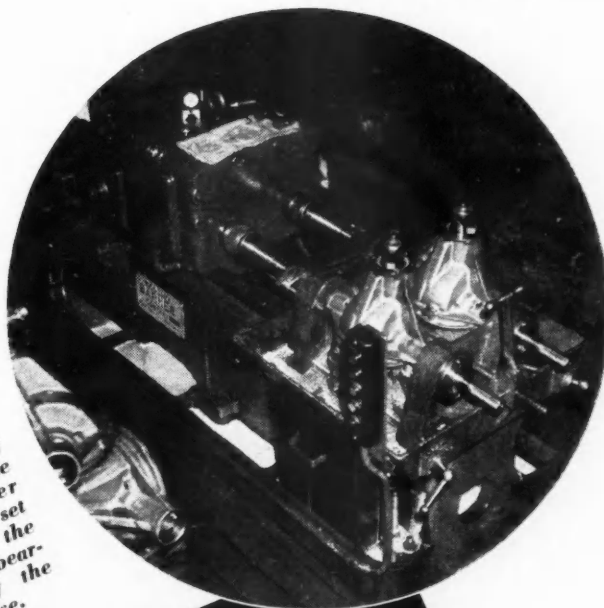
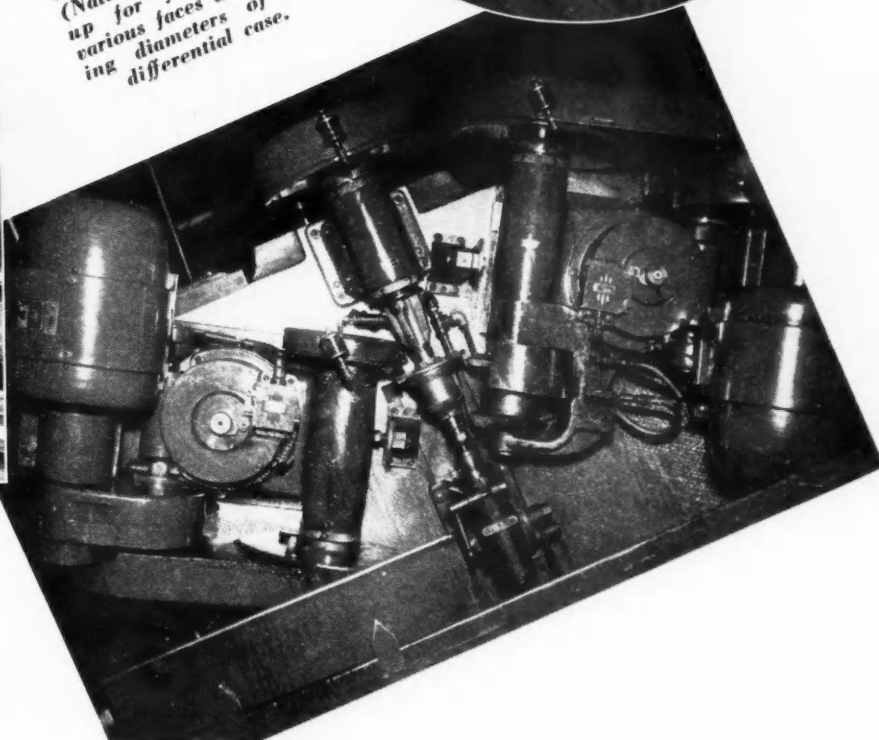
In the first, or rough honing operation, approximately 0.003 in. stock is removed in 20 to 25 seconds, followed by a delay of 10 to 15 seconds during which the abrasive is "cutting out" for rough size.

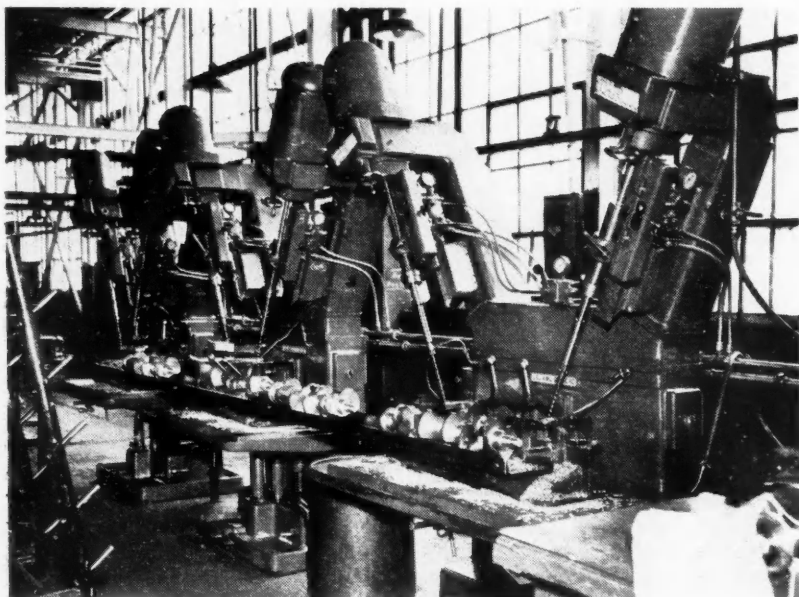
(Circle) W. F. & John Barnes, one-way, two spindle hydraulic boring machine on the rear axle housing.



(Above) L-head engine cylinder bores are finish-reamed individually, using a new type of Barber-Colman reamer. This view shows the battery of heavy-duty single-spindle Baker drill presses employed for this purpose.

(Below) Close-up of the work-station of the unique Roto-Shaver (National Broach) set up for finishing the various faces and bearing diameters of the differential case.





View of a battery of Leland-Gifford hydraulic feed sensitive drilling machines for drilling crankshaft oil holes.

In the second, or finish honing operation, approximately 0.0007 to 0.001 in. stock is removed in 10 sec. honing time, and an additional 20 sec. delay for cutting out to final surface finish.

Principal operation on the cylinder head is that of broaching the top and bottom surfaces on a Cincinnati hydraulic surface broaching machine having an input of 136½ hp., with a ram travel of 15.5 ft. The fixture is of drum type with four index positions 90 deg. apart. The machine, like the ones on the block line has an automatic scanning device.

In operation, the fixture is indexed through the use of limiting switches and a small motor. One rough head is placed in the top half of the fixture with its bottom face exposed while another rough head is placed in the bottom half of the fixture with the top exposed. After the operator presses the starting button, the fixture rotates with the top coming toward the operator. With the fixture in this position two heads that have just been broached will be on the top of the fixture and one of these two is finish broached on top and bottom. As the hydraulically operated pusher advances it pushes the finished head into the chute and the other head into the hinged elevator on the right side of the fixture. The elevator then swings 90 deg. while the drum fixture rotates another 90 deg. to bring the rough heads in broaching position against the face of the ram. As the broaching takes place, the half finished head in the hinged elevator is moved into position on the drum fixture at the top and another rough head is placed in the bottom.

One of the most compact flywheel machining departments to be found in the industry is the set-up for the new flywheel, comprising a battery of four Gisholt machines—

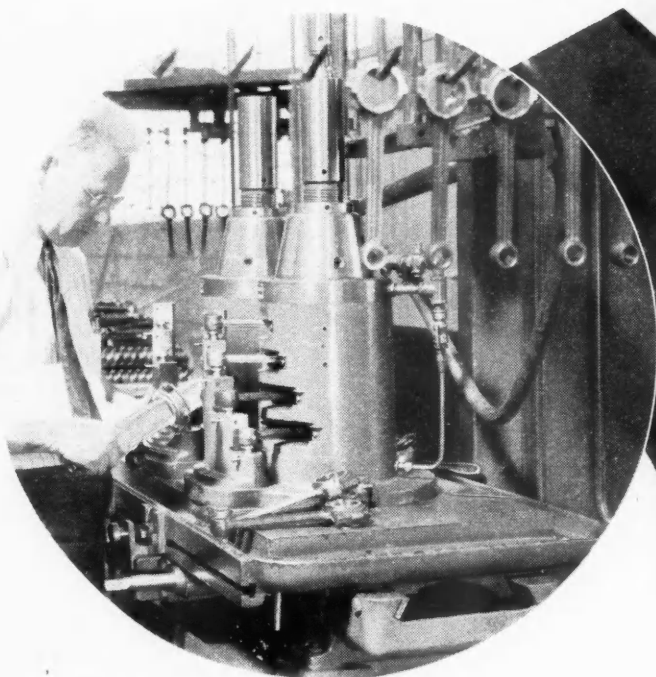
Gisholt radial type Simplimatics for the first and second operations. No. 12 Gisholt hydraulic automatic lathes for the third and fourth operations. This battery produces 37 flywheels per hour and is operated in two eight-hour shifts per day to turn out lots of 5000. Carboly tools are used throughout. The sequence of operations on the flywheel is given below:

Rough turn clutch side	Gisholt Simplimatic lathe
Rough turn crank side	Gisholt Radial type Simplimatic lathe
Drill and ream and tap 6 clutch holes—drill 6 flywheel to crank holes	Natco No. 3AL vertical holesteel drilling and tapping machine
Finish turn clutch face and O.D.	Gisholt No. 12 hydraulic automatic lathe
Finish turn face and dia. for crank flange	Gisholt No. 12 hydraulic automatic lathe
Press on ring rear, drill ¼ oil hole	Special hydraulic press and Kingsbury No. 16 drilling unit

Another of the new machine lines is the advanced department for crankshaft production. The general sequence of operations, as well as the listing of principal items of equipment is found on the routing reproduced elsewhere. We wish to make particular mention of the battery of new Landis hydraulic grinders installed here; also a special note on the Gisholt Dynetric balancing machine.

Prominent among the Landis grinders is the five-wheel machine—the Landis 16 in. x 40 in. Type IW hydraulic grinder which actually performs six different operations. Three of the wheels are used for the line bearings, one for the gear fit, while fifth wheel has a very wide face so grooved as to grind both the rear bearing and oil seal as well.

Single-wheel grinders used for finishing the crankpins are the standard Landis 16 x 32 in. Type D



Advanced type of Micromatic fixture designed to handle the honing of connecting rod big end bores four at a time. The fixture is installed on a Barnes hydraulic honing machine fitted with a Micromatic hone.

hydraulic machines. Interesting fact about the grinding procedure is that only a single grinding operation is performed after finish turning.

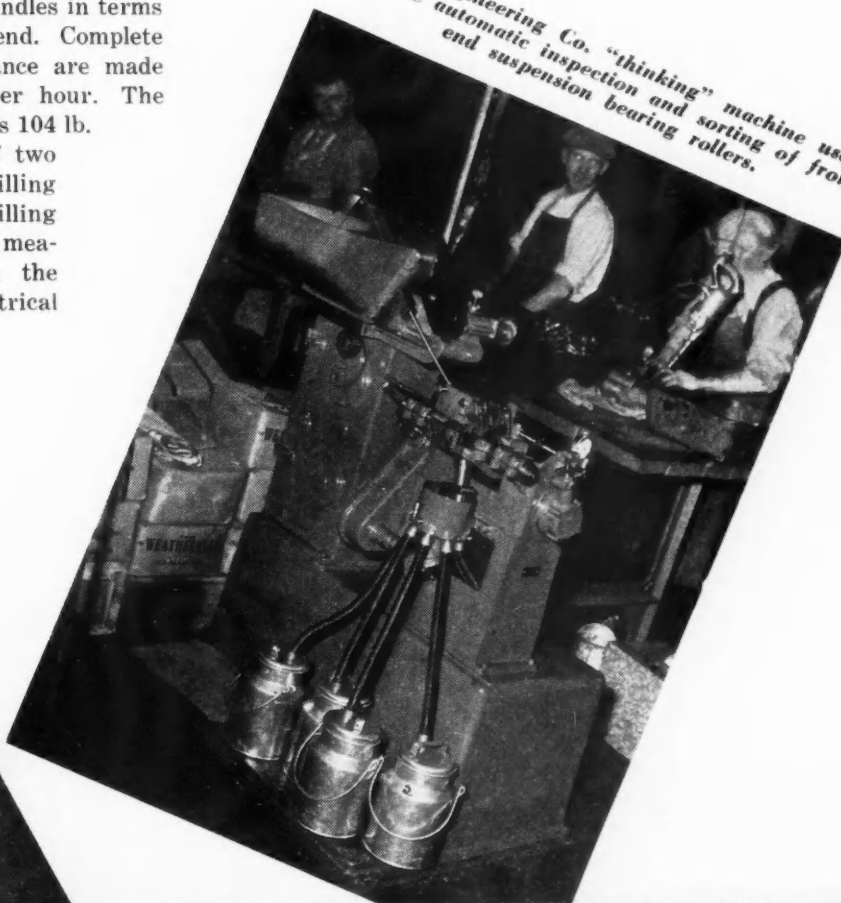
Two Gisholt Dynetric balancing machines are installed in the crankshaft department, each one performing the same functions. At Nash, the balancing is done on the complete assembly of flywheel, clutch, and crankshaft, the correction holes being drilled in the face of the flywheel and in the face of the vibration dampener. Unusual feature of the Gisholt machine is the ability to measure out-of-balance, balance-drill, and check balance, in a single setting in the same machine. The amount of unbalance, as indicated, is automatically transferred to the drill spindles in terms of the depth of a 1-in. drill at each end. Complete measurement and correction of unbalance are made at the rate of 20 to 30 assemblies per hour. The assembly measures 33 in. over-all, weighs 104 lb.

The machine consists, essentially, of two units—a balancing machine, and a drilling machine fitted with Leland-Gifford drilling spindles, electrically interlocked so that measurements of unbalance observed on the balancing unit are transferred by electrical

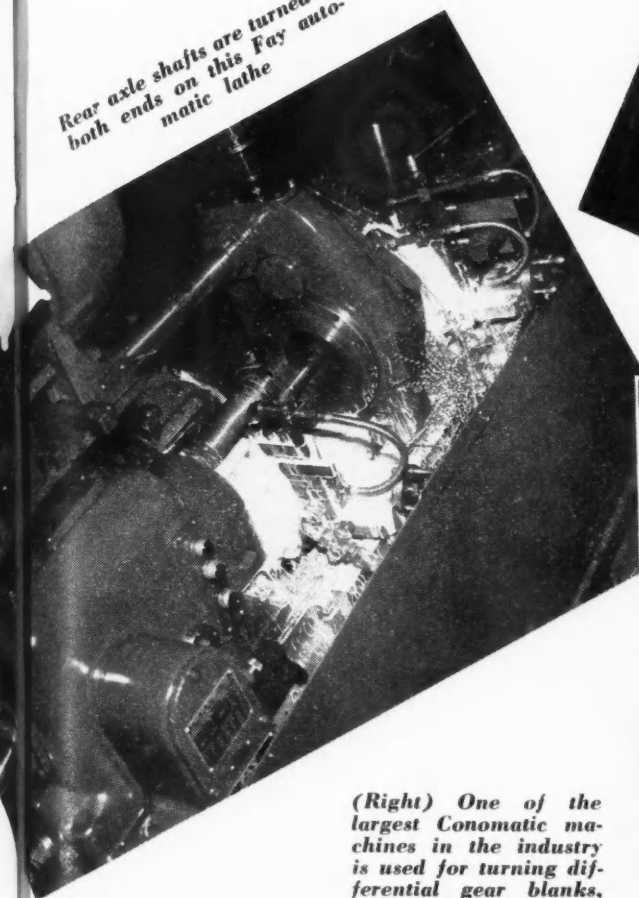
means to cams in the correction drilling spindles.

After the correction has been made at both ends of the assembly, the work is check-balanced by repeating the balancing operation. In a small percentage of balancing operations, the amount of correction may require the drilling of two holes instead of one. The need for this extra operation is indicated on the machine, permitting the operator to stop the machine

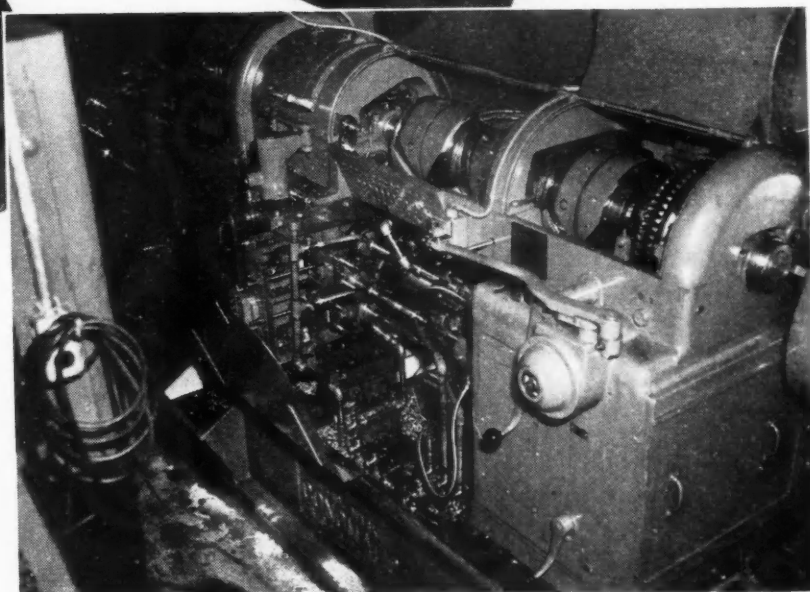
Foster Engineering Co. "thinking" machine used for the automatic inspection and sorting of front end suspension bearing rollers.



Rear axle shafts are turned at both ends on this Fay automatic lathe



(Right) One of the largest Conomatic machines in the industry is used for turning differential gear blanks, burnishing the bore and spherical seat in the same setting.



Factory Routing for Cylinder Block

OPERATION AND EQUIPMENT

MILL 4 location spots
Ingersoll 4-spindle traveling head milling machine

BROACH top and bottom
Cincinnati horizontal broaching machine

BROACH valve side and exhaust
Special Cincinnati horizontal broaching machine

DRILL, REAM and CHAMFER 2 location holes 0.6245 diameter, **DRILL** 8 main bearing stud holes, 1 3/8 hole, 1 5/16 and 1 1/4
Nasco No. 2AL vertical Hasteel drilling machine

MILL ends of block
Ingersoll 8-spindle traveling table milling machine

MILL sides of block (generator—water pump and distributor pads)
Ingersoll 4-spindle milling machine

ROUGH BORE cylinder, **OPEN** up valve ports, **DRILL** valve guide holes, **SEMI-FINISH BORE** cylinder, **DRILL** 4 angular oil holes **DRILL** 2—60 degree oil holes
Foot-Burt 7-station, 42-spindle fixed center unit type hydraulic feed drill and boring machine

DRILL and TAP all holes in top and bottom **STRADDLE**
MILL main bearings, **CUT** bearing lock notches
Greenlee drilling machine

BACK FACE spring seats and cut angular valve clearance
6-spindle Ingersoll facing and back facing machines

DRILL 12 tappet holes, **ROUGH REAM** tappet and valve guide holes and valve throat, **FINISH REAM** tappet valve guide and valve throat, **CHAMFER** top and bottom of cylinder bores, **SEMI-FINISH REAM** bores.
Foot-Burt 5-station type 44-spindle fixed center unit type hydraulic feed drilling machine

ROUGH and **FINISH** distributor holes, oil pump holes, oil relief hole and Welch plug holes on side, **TAP** all holes on side
Greenlee drilling machine

OPERATION AND EQUIPMENT

DRILL and TAP all holes in ends of block and Welch plug holes—**ROUGH CAM** holes
Greenlee drilling machine

ASSEMBLE Welch plugs
Oilgear special press

ASSEMBLE valve stem guides
Oilgear 25-ton Pushomall press

FINISH valve seats
Phillips valve seating machine

FINISH REAM cylinder bores
Baker No. 217 drill

ROUGH HONE bores
No. 214 Barnes multiple spindle cylinder hydraulically reciprocated honing machine

FINISH HONE bores
No. 214 Barnes multiple spindle cylinder hydraulically reciprocated honing machine

WASH

WATER TEST

ASSEMBLE bearing caps

FINISH bore cam, **SEMI-BORE** crank
Ingersoll 8-spindle cam and crank boring machine

PRESS in cam bearings
Oilgear 15-ton horizontal assembly press

MILL front bearing to width, cut oil grooves in rear bearing
Ingersoll 3-spindle facing and chamfering machine

FINISH BORE cam and crank and **REAM** transmission dowels
Ingersoll 10-spindle cam and crank boring machine

REMOVE bearing caps

ASSEMBLE valves, springs and retainer, **BRUSH** out tappet holes

ASSEMBLE valve spring retainer locks

Final INSPECTION

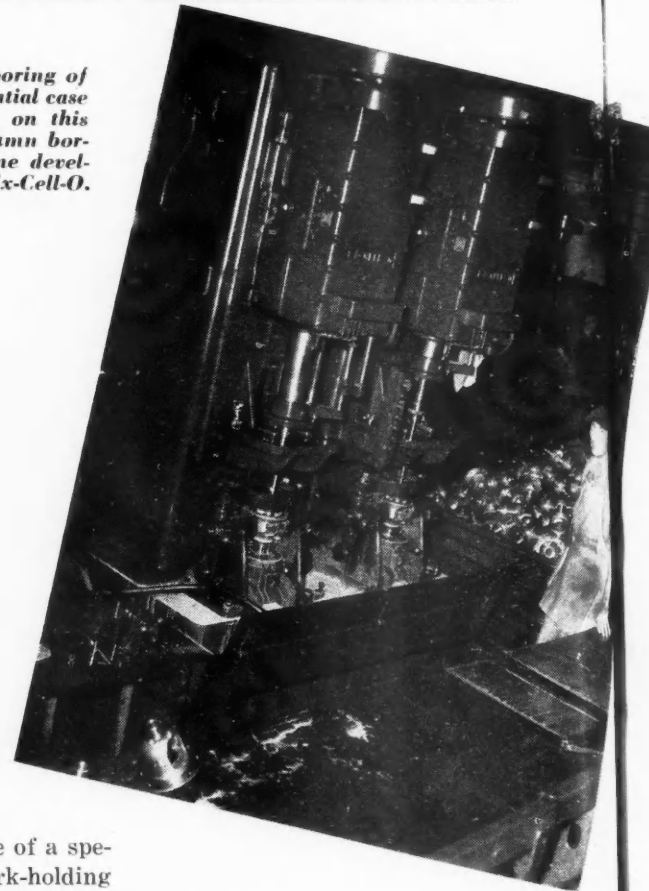
and to drill one hole to maximum depth, then to proceed with the final correction hole in the normal manner of operation.

Connecting rod machining has been worked out in excellent fashion, taking advantage of the latest developments along this line. The general arrangement of operations and equipment is shown on the routing, starting with the coining operation on the Version All-Steel press. Surface broaching operations are employed generously, one of the most interesting being the sawing off of the cap in a Cincinnati 5-54 Duplex hydraulic surface broaching machine. The operation is performed at the rate of about 433 pieces per hour with a ram cutting speed of 45.4 f.p.m.

The index table of this machine is equipped with two identical fixtures, one right hand and one left hand, of the automatic clamping type. The rod is located on a hardened insert and is held securely in position by means of a retracting toe clamp. The release and retracting of the clamp is actuated by means of a plunger and linking mechanism so fastened to the knee of the machine that when the fixture is in the loading position the work is unclamped.

In the final stages of finishing the big end bore, semi-finish boring is done on a Davis-Thompson drill, then broaching in an Oilgear horizontal broaching machine. Final operation is that of honing, performed in a Barnes Drill Co., single-spindle hydraulically reciprocated honing machine, fitted with a Micromatic honing tool. Two of these machines are available to handle the production of three different rods, one of them being fitted with two rod fixtures. Outstanding

Precision boring of the differential case is handled on this double-column boring machine developed by Ex-Cell-O.

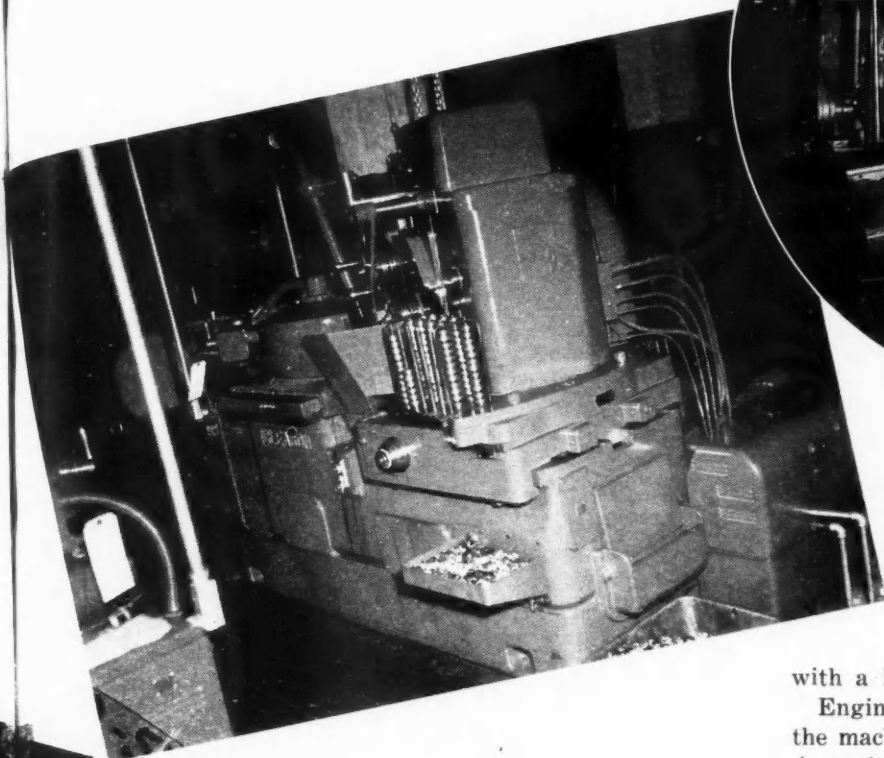


is the use of a special work-holding fixture which takes four rods at a time, stacked vertically.

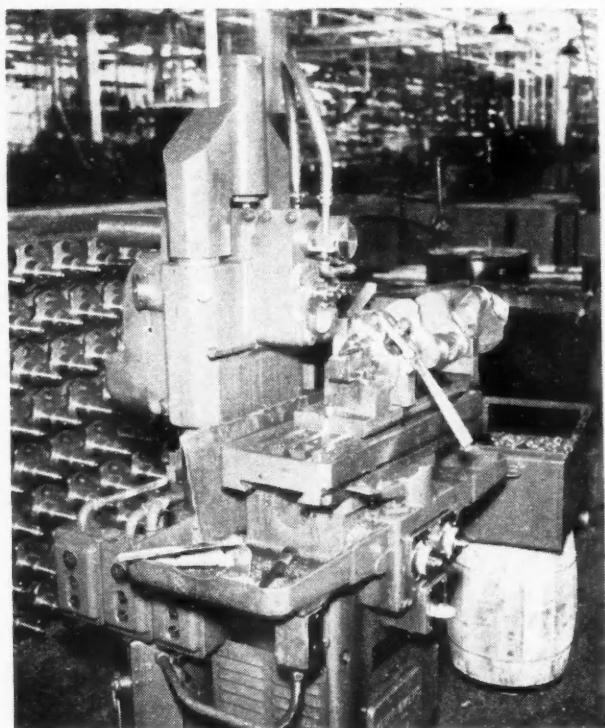
Production is of the order of 400 rods per hour, removing from 0.0005 to 0.001 in. stock in 10 to 15 sec.

(Circle) View in Nash foundry in Kenosha showing an Osborn core blowing machine producing valve chamber cores.

(Below) View of the new Gleason Revacycle machine for cutting differential pinions produces finish-cut gears in one operation from a rough blank.



(Below) Kent-Owens hydraulic milling machine is used for cutting keyways in crankshaft.



Wrist pin holes are finished in a Heald double-end Bore-Matic precision boring machine fitted with diamond flyout boring tools. The small hole is checked with a Sheffield 1000 to 1 magnification visual gage. The big end bore is checked after honing with a Pratt & Whitney Internal Electrolimit gage.

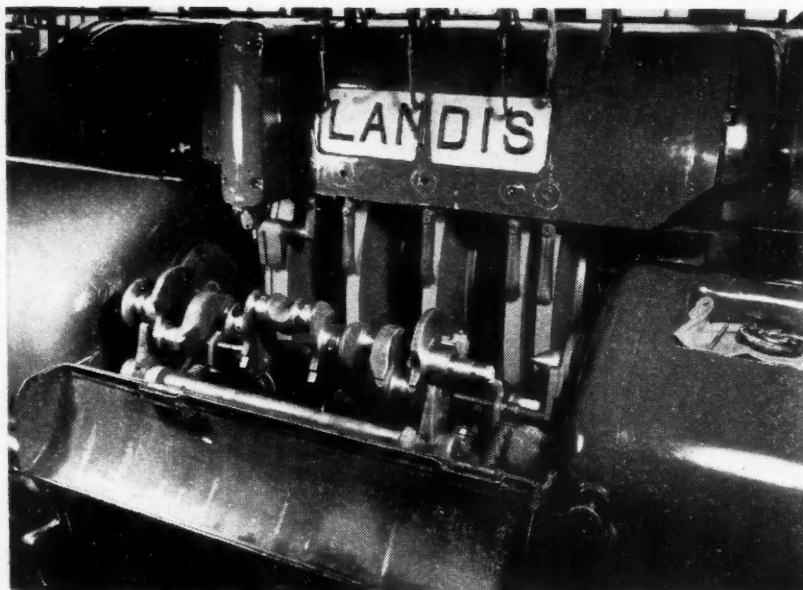
Engine assembly lines are built at right angles to the machine line and are housed in the new addition. A special line is provided for the small engine; parallel lines for the valve-in-head engines. From the assembly lines, the engines are transported by monorail to an overhead Binks double spray booth, then to a station where accessories are installed, then to the shipping dock from which the engines are trucked over to the final assembly building.

Front Suspension

This is a new department devoted to the production of front end suspension elements and the assembly of front end units. Perhaps the most interesting details in this department are those concerned with making the steering knuckle, the steering knuckle bearing sleeve, kingpin, and the checking of bearing rollers. The steering knuckle operations are listed in a factory routing reproduced elsewhere. Both the tube and kingpin are made of S.A.E. 4615 nickel-moly steel, the sleeve of seamless tubing while the kingpin is of bar stock. Both parts are heat treated to a surface hardness of R. 60, the kingpin being centerless ground to size after heat treatment.

The only unusual operation on the sleeve is that of honing the inner diameter on a special 4-spindle Barnes honing machine, fitted with Micromatic honing tools. Stock removal is of the order of 0.003 to 0.005 in. for rough and finish-honing operations, at the rate of 900 to 1000 pieces per three-shift day.

An example of what has been popularly called a



Close-up of the new Landis five-wheel crankshaft grinder. Note that the wide-faced wheel at the extreme left is grooved so as to take both the rear bearing and the oil seal at the same time.

"thinking" machine is found in this department. This is the inspection device for automatically checking every dimension of the small hour-glass bearing rollers, accepting only those which come within the specified limits, sorting all accepted rollers into five different classes or grades. As may be noted in the illustration, the machine is fitted with a hopper feed mechanism holding about an hour's supply of rollers. If the rollers are within the specified limits, the machine will check and grade automatically and without further attention save for replenishing the feed mechanism. It is entirely mechanical in its operation and is driven by a 1/3 hp. motor.

Briefly the operation of the machine, which has been developed by the Foster Engineering Co., Ferndale, Mich., is as follows: It is of the cycle type, going through one complete revolution for each roller in the measuring station. As the rollers move down the magazine track from the hopper, they pass through a preliminary snap gage which holds up any rollers which may be 0.0002 in. oversize in excess of the maximum diameter, as a safety measure to protect the gaging mechanism.

The rollers now proceed through a transfer block and feed mechanism to the measuring points where they rest for an instant. The roller rests between the measuring contacts until the gap between the gaging points is sufficiently large to permit it to drop through an opening into the distributor funnel. The Nash machine has a measuring head of seven-station type, arranged to select the rollers in the following pattern—first station, undersize rejection; second, third, fourth, fifth, and sixth stations, select acceptable rollers within steps of 0.0002 in. variation; the seventh station is for oversize rejections. The machine will grade rollers at the rate of about 36 per min.

Coming back to the operating cycle, consider the action of the distributor funnel. It is arranged to

revolve and is so synchronized with the gap-actuating mechanism as to be in the proper position to deposit the gaged rollers in one of five different channels, leading to suitable receptacles, each one corresponding to the grade selected by stations two to six, inclusive. The control of the gap actuation is by cam action on a shaft with amplification of 20 to 1.

Axle Department

A new axle department, replete with some of the latest items of equipment known to the art, is a bright spot in the Kenosha operation. Among other things, it contains a large battery of Gleason equipment of every variety required for axle gearing. One of the most unusual of these is the Gleason Revacycle machine, designed for rough and finish cutting of straight bevel gear teeth in one operation. This machine, first announced in *AUTOMOTIVE INDUSTRIES*, Sept. 1, 1940, is used in the production of the 10-tooth differential side gears.

The operation of the Revacycle machine is entirely automatic. It has three work-holding stations, two for loading and unloading, the third for cutting. As a gear is finish-cut, the turret automatically indexes around to bring a blank into cutting position.

First operation, that of preparing the gear blank, is accomplished on a new 17/8-in. eight-station Cono-

Three-spindle Heald precision boring machine is used for boring connecting rod wrist pin holes, three at a time.



Factory Routing for Front Wheel Steering Knuckles

OPERATION AND EQUIPMENT

CENTER both ends
No. 53 Sundstrand cent ring machine 4 x 12 in.

TURN stem
Fay lathes

RECENTER

ROUGH GRIND 2 bearings
Landis grinder

ROUGH and FINISH FACE flange and oil sling diameter
Fay lathes

DRILL, TAP and REAM flange holes
W. F. & John Barnes No. 914 drilling machine

DRILL, ROUGH and FINISH taper **REAM** steering arm hole
W. F. & John Barnes vertical No. 914 drilling machine

SPOTFACE small end of taper hole
Avey drill

OPERATION AND EQUIPMENT

BROACH keyway and **REAM** burrs
American broach

THREAD stem end
Landis threader

MILL keyway
Hand mill

DRILL cotter pin hole
Kingsbury drill

RECENTER
Leland-Gifford machine

FINISH GRIND 2 bearings
Landis grinder

DRILL, SPOTFACE and TAP 5/8-18 hole
W.F. & John Barnes vertical No. 914 drilling machine

CORE DRILL and taper **REAM** large hole
W.F. & John Barnes No. 914 drilling machine

matic. Interesting feature of the tooling is that the automatic handles the burnishing of the bore and convex bearing surfaces along with the blanking operations.

The differential case tooling also lifts it out of the conventional with equipment that is well worth special attention. Preparatory rough turning of the flange and bearings is done on a Fay automatic lathe, with Carboloy-tipped tools for a number of operations.

Abandoning the conventional procedure, Nash employs a Red Ring Roto-Shaver for finishing the flange and bearing surfaces, making a marked improvement over the former method of grinding these same sur-

faces. The machine is arranged for a 38-sec. cycle plus a few seconds for loading and unloading. The loading station is fitted with two arbors, permitting the operator to load one piece while the other is being finished.

In detail, the machine is tooled to surface-shave three diameters and three faces. The right-hand spindle has two large cutters, takes two diameters and two faces; the left-hand spindle takes the third diameter and face. Stock removal is of the order of 0.015 in. on the diameters, 0.012 in. on the faces. Diameters are held to close tolerances while the distance between the flanges is held within plus or minus 0.003 in. Incidentally, the two end diameters, for the end bearing fits, are maintained at about 85 per cent bearing area so as to provide the desired press fit conditions.

The shaving cutters on this machine are made with great accuracy. They are similar in design to milling cutters except for the fact that they have very fine teeth, accurate lands, precise face angles, and are free from eccentricity.

The machine is completely automatic in its operation, once the operator presses the starting button, going through the following cycle—rapid advance of slides into the work, feed to depth, dwell, then rapid return to starting position.

Among the special items of equipment on the case are two Ex-Cell-O precision machines, one for facing the pinion seats, the other, a two-column machine for rough- and finish-boring and facing for side gears. The latter machine has two stations, one for roughing and one for finishing operation. Openings in sides of the part permit the cutter head, mounted in a fixed bracket, to pass inside. Two 0.625 dia. hardened pins locate in opposite sides of the work to position it radially. Brackets, carrying

(Turn to page 148, please)

Nocturnal scene in the new engine building. This gives some idea of the remarkable daylight conditions afforded by the new Fluorescent lighting installation.



At the Motor Boat Show

Thirty-five engine 300 marine models

THIS year's National Motor Boat Show, the thirty-sixth of the series, which opened in Grand Central Palace, New York, on Jan. 10, was the largest exhibition ever staged by the National Association of Boat and Engine Builders. No less than 141 exhibitors took part, about 20 more than last year. Approximately 300 marine engines were shown, including some of quite recent design.

The trend toward Diesel engines continues. Steel is being used to a larger extent for engine blocks and other structural parts, to cut down weight, and aluminum is finding increased application for pistons and similar parts. Old-line engine builders are increasing horsepowers throughout their lines.

Buda, a pioneer builder, has entered the heavy-duty marine field with a new Buda-Lanova, and Caterpillar Tractor Co. has added two Diesels to its line of marine engines. Atlas Imperial Diesel Engine Corp. offers a new six, and Cummins Engine Co. showed three supercharged powerplants against one last year. A new 12-cylinder, Vee engine was shown by Sterling Engine Co., and the Cleveland Diesel Division of General Motors Corp., still known affectionately among the boating fraternity as Winton, showed a new eight-in-line, compact engine which was developed primarily for the U. S. Navy and the Coast Guard. This engine has a welded steel block of Lukenweld construction.

Of the three new Kermath engines, one was a Diesel, and Mack International Truck Corp. introduced two new marine engines, bringing their line of powerplants for boats to six. Other new models offered were shown by Palmer Bros. Engines, Inc., Red Wing Motor Co., Scripps Motor Co., Gray Marine Motor Co., and several manufacturers of outboard engines.

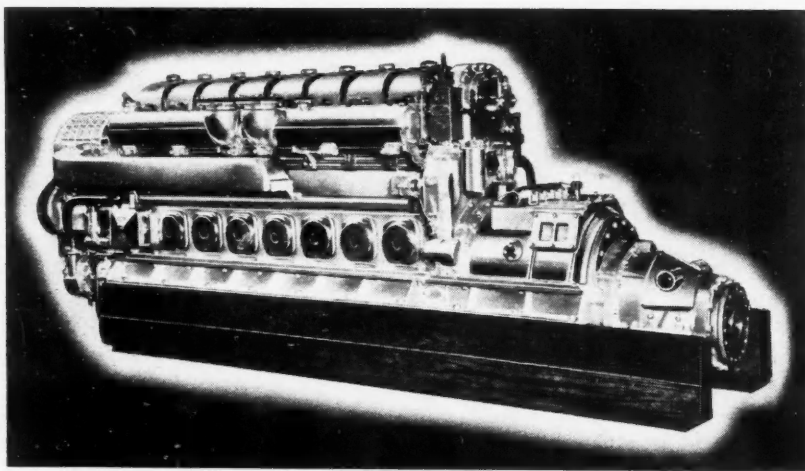
Thirty-five manufacturers of gasoline and Diesel engines exhibited the whole or a part of their line of marine engines, ranging from fractional to 1200 hp.

Sterling Engine Co., Buffalo, N. Y., showed its newly developed Admiral, a modified Vimalert design. This is a 12-cylinder, 60-deg. Vee engine of 6 $\frac{3}{8}$ -in. bore and 6 $\frac{1}{2}$ -in. stroke. It is supercharged, and with a displacement of 2500 cu. in. it develops 1200 hp. The compression ratio is substantially 6, and the weight of the engine, complete with all accessories, is 3980 lb. Cylinder blocks are of aluminum alloy and are fitted with forged, removable liners of chrome-molybdenum steel. There are two spark-plugs in each cylinder. Aluminum-alloy pistons are used.

The new Buda-Lanova six has a bore of 6 $\frac{3}{4}$ in. and a stroke of 8 $\frac{3}{4}$ in., giving it a displacement of 1879 cu. in. Ni-chrome iron is used for the crankcase and cylinder block, as well as for the cylinder head. Alloy-cast-iron liners are used, and replaceable exhaust seats are provided. The engine has seven crankshaft bearings, 3 $\frac{3}{4}$ in. in diameter, of the steel-back removable-shell type. Connecting rod bearings are of the same type. The camshaft is supported in seven bearings, six of them of 3-in. and the one at the driving end of 2 $\frac{3}{8}$ -in. diameter. Drive of the camshaft is by helical gears. Connecting rods are rifle-drilled for pressure lubrication. Three compression and two oil rings are used. Piston pins are of the floating type, 2 $\frac{3}{4}$ by 5 $\frac{1}{2}$ in. in dimensions. The engine develops 248 hp. at 1100 r.p.m. and is rated 222 hp. at 1000 r.p.m., this being the speed recommended for cruising.

Caterpillar Tractor Company demonstrated its faith in the marine field by introducing two new marine Diesel engines, bringing its line up to seven models. The two new units have four and six cylinders and develop 60 and 70 hp., respectively. These engines are said to be easy to install, only five connections needing to be made.

The new offering of the Atlas Imperial Diesel Engine Corp. was a six-cylinder unit rated 135 hp. at 900 r.p.m. It is a 6 $\frac{1}{4}$ x 8 $\frac{1}{4}$ -in. engine, with main journals of 4 $\frac{5}{8}$ in. diameter, or 75 per cent of the bore. Individual Bosch fuel injectors are employed. Full pressure lubrication is



General Motors eight-cylinder in-line two-stroke Diesel engine with reverse and reduction gear.

Show

**manufacturers showed approximately
with a continued trend to Diesel designs**

used on all main bearings, connecting-rod bearings, and camshaft and rocker bearings. A dual lubricating pump is provided, one side of which is used to transfer oil from the sump to the oil tank, the other to maintain the required pressure in the lubricating system. The cast-iron base extends the full length of the cylinder block and gear housing, resulting in an extremely rigid engine and insuring permanent alignment of the main bearings. The cylinder block is cast in one piece, and is fitted with liners of forged alloy steel.

The Cummins Engine Co. offered a supercharged six-cylinder engine with 7 by 10-in. cylinders, rated 325 hp. at 1000 r.p.m. The cylinder block is a one-piece casting, but cylinder heads are cast singly. Valves have been increased in size to $2\frac{3}{4}$ in. Chrome-nickel iron is used for pistons, which are cam-ground. Five compression and two oil rings are used. The engine has seven main bearings. It is started by air. The whole Cummins line uses the company's exclusive injection system. The new engine weighs 11,900 lb., with all standard accessories.

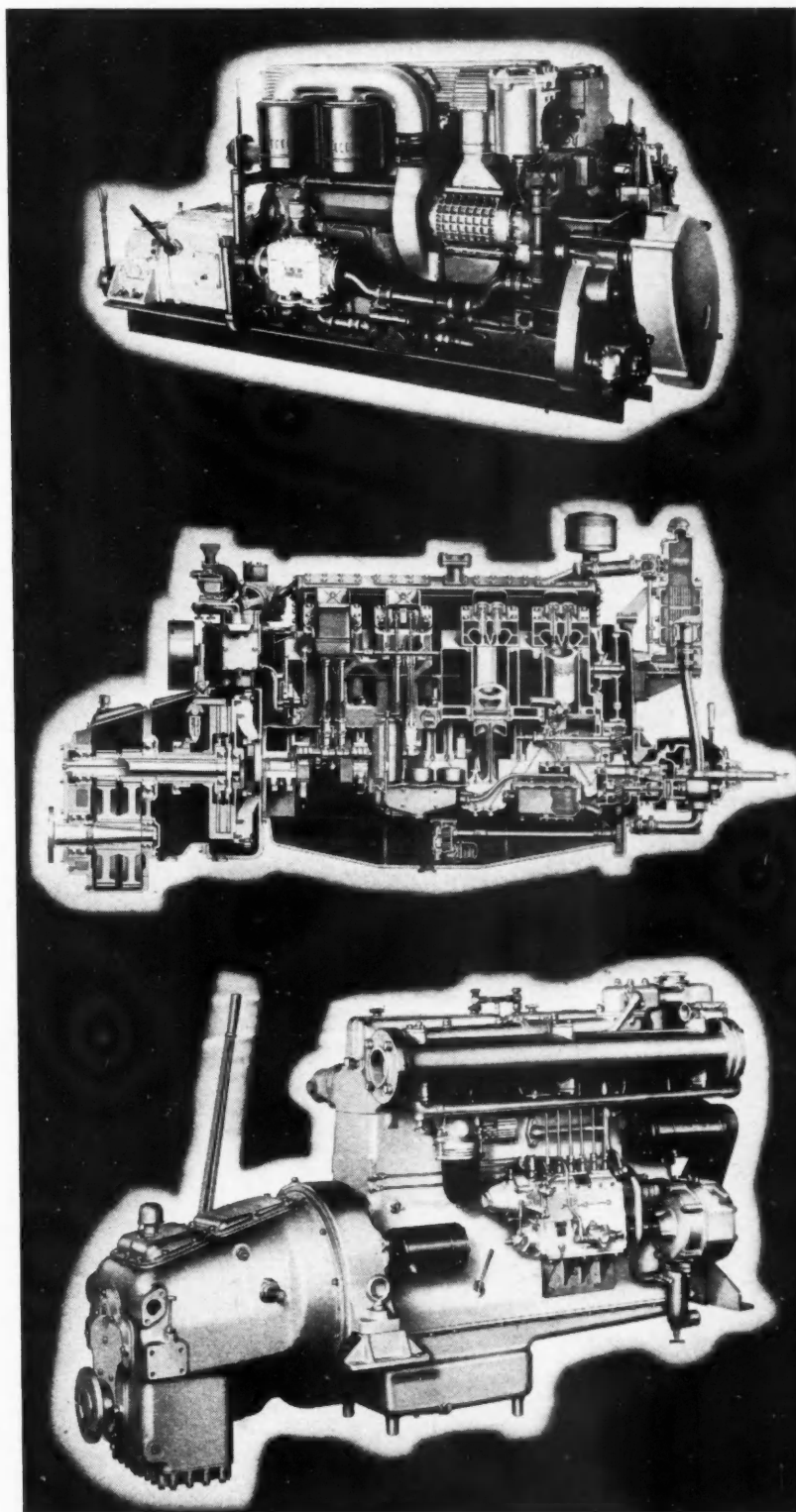
Kermath offered three new engines, two of the carburetor type and one a Diesel. The latter is rated 27 hp. at 1800 r.p.m. Its two 4 x $4\frac{1}{2}$ -in. cylinders give it a displacement of 113 cu. in. It has

(Turn to page 145, please)

(Top) Cummins six-cylinder 325-hp. supercharged Diesel engine, Model LMRS-600.

(Center) Caterpillar eight-cylinder marine Diesel engine, Model D-17000.

(Lower right) Vigilant Waukesha-Hesselman marine oil engine with Twin-Disc reverse and reduction gear.



MARINE ENGINES

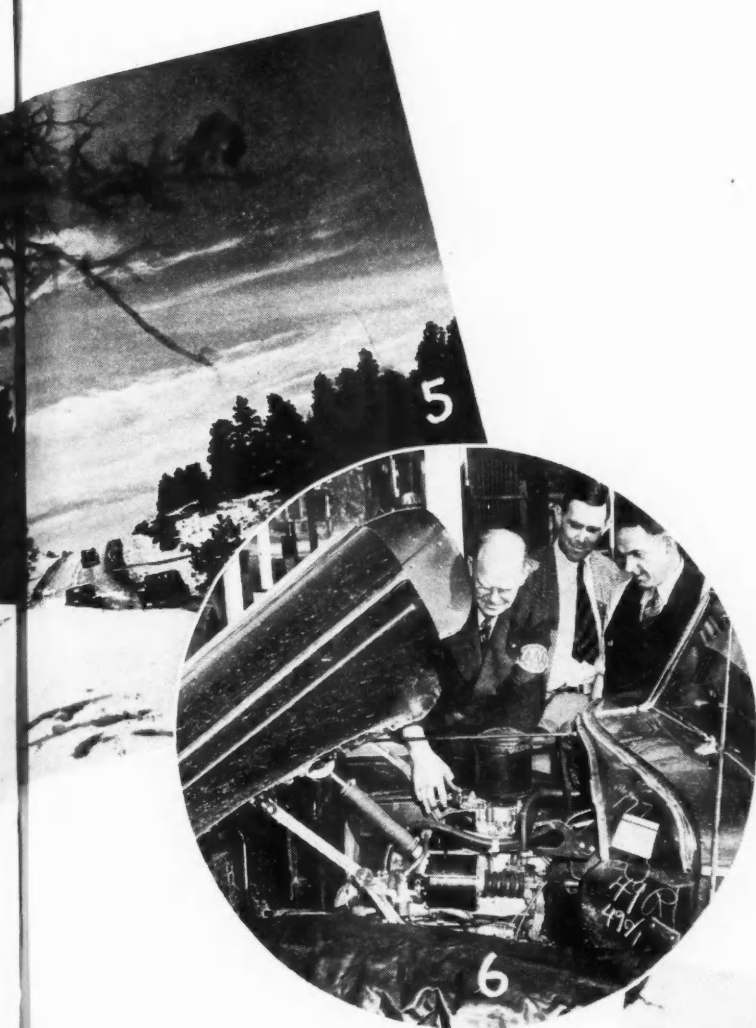
Grand Canyon Run in V



February 1, 1941

Automotive Industries

Views and Figures



Results of 1941 Gilmore Grand Canyon Run

Price Division	Position	Make	Av. Miles Per Gallon	Av. Miles Per Hour	Av. TMPG
A	1	Willys Plainsman*	29.06	42.41	48.624
A	2	Willys Plainsman*	28.40	42.42	47.319
A	3	Willys	25.18	42.40	41.334
B	1	Ford	23.05	43.19	49.557
B	2	Plymouth	21.71	43.22	43.417
C	1	Nash 600*	25.81	42.60	46.651
C	2	Studebaker Champion*	24.61	42.64	45.003
D	1	Hudson 6 De Luxe*	24.96	43.19	50.969
D	2	Mercury	23.35	42.58	50.895
D	3	Dodge	22.47	42.32	48.425
E	1	Studebaker Commander*	24.36	42.84	52.975
E	2	Nash Ambassador 6*	23.16	42.37	51.512
E	3	De Soto	20.04	46.59	42.632
F	1	Studebaker Pres.*	22.53	42.32	51.988
F	2	Nash Ambassador 8*	21.18	42.52	48.579
F	3	Chrysler Royal*	19.71	42.60	44.060
G	1	Chrysler Windsor*	20.14	43.39	44.988
H	1	Packard 120*	19.78	43.41	46.846
H	2	Hudson Commodore 8*	20.18	43.31	45.906
H	3	Chrysler Saratoga	WITHDREW (Minor Accident caused leak in fuel tank)		
I	1	Lincoln Zephyr**	22.96	42.91	57.749
I	2	Chrysler New Yorker*	17.47	42.69	42.956
J	1	Lincoln Custom**	21.03	44.38	57.827
J	2	Chrysler Crown Imp.*	16.46	42.95	46.265

SWEEPSTAKES WINNERS

First	Lincoln Custom	57.827	TMGP
Second	Lincoln Zephyr	57.749	TMGP
Third	Studebaker Comm.	52.975	TMGP

Legend: TMGP—TON-MILES-PER-GALLON

*—Equipped with overdrive transmission

**—Dual overdrive—i.e. Dual ratio axle and overdrive transmission

Twenty-three stock sedans averaged 22.50 miles per gallon. Winners in each of the Price Divisions, as well as the Sweepstakes Winner, are judged by A.A.A. officials on the ton mileage basis. This is computed by multiplying the weight of the car in tons, times the miles traveled and dividing by the number of gallons of gasoline used.

1. On the starting line at Los Angeles
2. At the finish of the run tanks are refilled to capacity
3. AAA official calibrating displacement of cylinder at the impounding lot before the start of the race
4. Refueling en route
5. The course for the race was marked by its scenic beauty
6. Checking and sealing the carburetor at the impounding lot before the start
7. The Lincoln V-12 which won the sweepstakes. Marshall Martin was the driver. The AAA officials are R. Frank Elliott and George Schleicher



New Ideas In the Field of

By P. M. HELDT

THE PROBLEM of a suitable correction formula for brake horsepowers of Diesel engines, which is at present under consideration by a sub-committee of the S.A.E. Diesel-Engine Division, differs materially from that of a similar formula for carburetor engines and involves difficulties that are not generally recognized.

In the case of a carburetor engine, if the surrounding atmosphere becomes denser, owing to a drop in temperature or a rise in the barometric pressure, the engine draws in not only more air, but also proportionately more fuel, so that the mixture ratio remains constant. Owing to the increase in the charge of combustible mixture aspirated, more heat is generated and more power developed. Variations in power, therefore, follow variations in the atmospheric density automatically.

With a Diesel engine, on the other hand, if the density of the atmosphere increases, only the air charge increases, and that in the same measure as in a carburetor engine. The amount of fuel supplied to the engine is not controlled by the force which governs air induction. It is controlled mechanically by means entirely independent of atmospheric conditions, and it, therefore, does not change when the atmosphere surrounding the engine becomes denser. If only the density of the atmosphere changes there is little reason for expecting an increase in engine power. The engine will get more air, it is true, but it will have no fuel to take advantage of this additional air, unless it previously operated with a deficiency of air or an excess of fuel. To utilize the additional air for combustion purposes, it is necessary to also supply additional fuel, by making suitable adjustments on the injection-control system. In contrast to what happens in the case of the carburetor engine, the power of the Diesel does not vary spontaneously with a change in atmospheric conditions.

We have now to consider two cases—that of experimental engines in connection with which means are provided for adjusting the injection limit as desired, and that of commercial or stock engines, in most of which the maximum injection quantity is definitely

fixed by a stop on the injection-control rack, and in some of which the adjustment of the stop is protected by a seal. It is obvious that with these latter engines the maximum horsepower generally is determined by the amount of fuel which the injection stop permits to be injected. There is an exception only when the engine is being operated in such a tenuous atmosphere—at a high altitude, for instance—that it does not get enough air to completely burn all of the fuel injected. It is only in cases of this kind, where the combustion is limited quantitatively by the amount of air present, that the application of a correction factor is justified.

In the case of experimental engines, where means are provided to vary the injection-stop position as desired, if the latter be set at the smoke limit, there is good reason for assuming that with a change in atmospheric conditions, if the injection stop is adjusted to give the same freedom from smoke in the exhaust as originally, the horsepower will change in direct proportion to the atmospheric density.

Carburetor-engine horsepowers are corrected to "standard atmosphere," that is, an atmosphere of dry air at 29.92 in. of mercury column pressure and 60 deg. Fahr. temperature. Now, engines on a test stand practically never breathe in an atmosphere of corresponding density. The barometric pressure may or may not be lower, but the temperature at the carburetor air inlet is al-

ways materially higher. The result is that correction factors applied to test-room dynamometer horsepowers are always above unity. They enable the manufacturer to claim for his engine a somewhat greater horsepower than the best he can get out of it under normal test-room conditions.

I don't mean to give the impression here that engine manufacturers or engineers purposely contrived the formula for the correction factor to give fictitious horsepower values. It was recognized that the engine output is influenced by the density of the atmosphere, and to make results of tests conducted at different times and in different places comparable, the results had to be adjusted to a common atmospheric density level. The concept of the "standard atmosphere" was already an old one at the time, and it was only natural to adopt that as a base, even though automotive en-

ON this and the following pages appear comments on a proposed new correction formula for Diesel engine brake horse powers and abstracts of papers presented at the S.A.E. annual meeting relating to Diesel fuels, test equipment, lubrication, etc.

Diesel Engine Instrumentation

Determining Fuel Spray Characteristics—Accurate Reading of Engine Speeds—Measuring Ignition Lag—Analyzing Exhaust Gases

gines do not spend their active life in such an atmosphere.

The S.A.E. Diesel Engine Sub-Committee deserves credit for having recognized the fact that the average atmospheric density in engine test rooms would be a better level than the so-called standard atmosphere to which to correct observed horsepowers. The temperature in test rooms is usually rather high, and is assumed to have an average value of 90 deg. Fahr. Moreover, the atmosphere of the test room is not dry, as a rule, but may be considered to contain 50 per cent relative humidity, on the average. Further, test rooms are seldom located at sea level—to which the standard atmospheric pressure of 29.92 in. of mercury column refers—and 500 ft. above sea level is assumed to be their average altitude. Making allowance for all of these variations from the conditions of the standard atmosphere, it is figured that a barometric pressure of 30.212 in. of mercury in the test room at 90 deg. Fahr. corresponds to 29.92 in. in dry air of 60 deg. Fahr. at sea level, and 30.212 in. therefore is made the pressure level to which Diesel horsepowers are to be corrected. The absolute temperature to be used in the correction formula is to be 550 degs. (90 deg. Fahr.) instead of 520 degs.

Two of the changes made in the horsepower correction formula tend to give a lower corrected horsepower, namely, the change from sea level to 500 ft. altitude and the change from 60 to 90 deg. Fahr. for the conditions to which corrections are made. The third change, the assumption that the atmosphere in which the engine is being tested contains 50 per cent relative humidity, instead of being dry, and the provision that the atmosphere to which correction is made also shall contain 50 per cent relative humidity, will tend to raise the corrected horsepower.

When observed horsepowers are corrected to the atmospheric density level which it is now proposed to specify, the cor-

rection factor should be below unity as often as above, and in most cases it should differ from unity by negligible amounts.

It should, perhaps, be pointed out that the subject is still in the state of discussion and the new correction-factor formula has not yet been formally adopted.

A PROCEDURE for determining Diesel fuel-spray characteristics, developed by the Gas Power Engineering Department of the International Harvester Company, was described in a paper by H. F. Bryan of that company. To determine spray-droplet sizes (or fineness of atomization), use was made of the Woeltjen method. This consists in spraying the fuel into an emulsifying liquid which holds the individual fuel particles in suspension, preventing their coalescence; then placing part of this liquid in a microscope slide and photographing it. A print from the negative is then used for the drop count. The liquid used by IHC is said to be an original preparation and to give reliable results with droplets smaller than 65 microns.

A receiving vessel containing 300 ml. of the gum solution is placed at $\frac{3}{4}$ in. from the nozzle. Approximately ten "shots" are allowed to enter the receiving liquid. The number may be varied, and experience will soon show the most desirable quantity. Formulas for the emulsifying liquid were given in an Appendix to

the paper. Two solutions, A and B, are prepared first. Solution A consists of 5 grams. of gum tragacanth powder in 1000 ml. distilled water. Small portions of the gum are ground together with water in a mortar to a smooth, thick paste. These portions are then poured into the remainder of the distilled water and the whole is thoroughly shaken. Solution B consists of 1 gram white soap (Swift & Co. Amazon floating soap), 100 ml. ethyl alcohol and 400 ml. distilled water. Solution C, the emulsifying liquid, is made up of 285

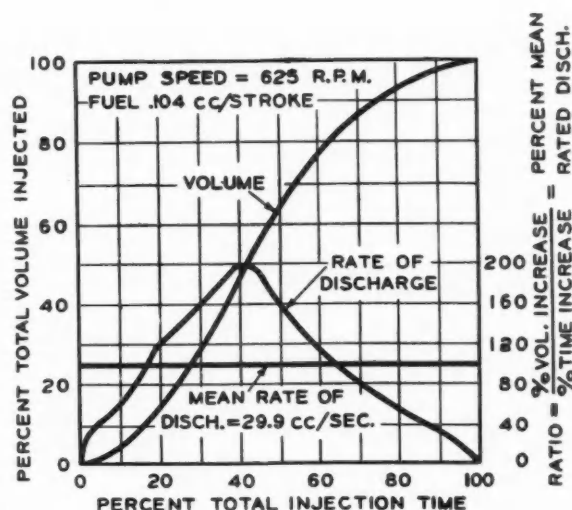


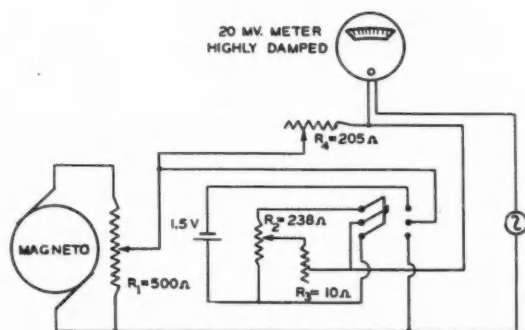
Fig. 1—Volume delivery versus injection time. Data for these curves obtained from spray delivery rate machine

in the ignition lag due to changes in fuel quality are indicated as changes in the micro-ammeter reading, but most cycle-to-cycle variations are damped out.

Referring to the accompanying wiring diagram, the injection-relay tube is tripped by a voltage impulse from the injection contactor, and passes current for the ignition lag period of approximately 13 deg. The meter, which indicates the ignition-lag interval, is connected in this circuit only. The combustion relay tube is tripped by a voltage impulse from the combustion contactor. Characteristics of these circuits are such that only one tube may pass current at any given time; therefore, the current through the injection relay tube is stopped at the start of combustion.

To transfer current flow from the injection relay tube to the combustion relay tube, plate circuits of the two tubes are connected by a small condenser. The initial current surge through the combustion relay tube is drawn from this condenser, having the effect of bypassing the injection relay tube current. Current flow through the injection relay tube is thus arrested, and the grid resumes control until the next voltage impulse is received from the injector. The ignition delay period of 13 deg. has been accounted for in the description up to this point. The combustion relay tube passes current during the remaining 707 degrees of the complete cycle. The end of this cycle marks the time at which the injection valve opens, tripping the grid of the injector relay tube. The combustion relay tube current is then stopped and the current flow bypassed to the injection relay circuit in the same manner as described above.

A DUAL-RANGE, vernier-type, electric tachometer designed to make possible very accurate readings of engine speeds was described in a paper by H. V. Nutt and W. F. Joachim, both of whom are connected with the U. S. Naval Engineering Experiment Station at Annapolis. The instrument has an upper coarse scale of graduations extending from 0 to 1000 r.p.m., individual divisions representing 10 r.p.m., and a lower fine set of graduations extending from 700 to 800 r.p.m., each scale unit being 1 r.p.m. The essential parts of the tachometer are (1) a shaft-driven D.C. magneto developing 0.4 v. at 1000 r.p.m.; (2) a highly damped milli-voltmeter with 7-in. scale, the full-scale deflection being obtained with 20 mv.; (3) a dry cell; (4) two wire-wound potentiometers of 238 and 500 ohms resistance, respectively; (5) two wire-wound

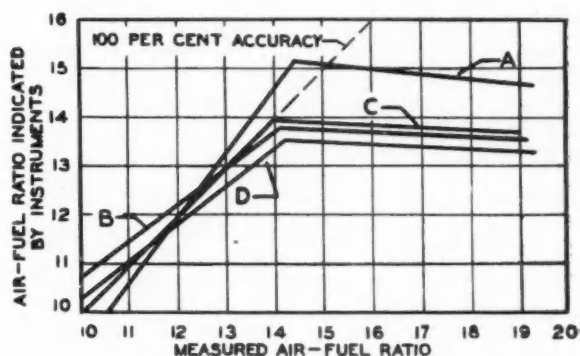


Dual-range vernier electric tachometer wiring diagram

rheostats of 10 and 205 ohms resistance, respectively, and (6) one 3 PST switch.

The circuit shown in the accompanying diagram is used with the vernier speed range. The changeover from the coarse to the fine range is made by closing switch *S*, which puts the dry cell across the magneto terminals, but with opposite polarity. The dry cell voltage is adjusted by means of potentiometer *R*, and tickler rheostat *R*, to balance the magneto voltage at 750 r.p.m., which is the normal operating speed of the test engine. The rheostat *R* is shunted out, so that the effective voltage is impressed directly on the 20 mv. meter. A change of speed and, hence, a change in magneto voltage, will cause the meter hand to deflect a proportional amount. The magnitude of this deflection for any given speed change depends on the initial setting of the magneto potentiometer *R*. In practice it has been set to give full-scale deflection for a change in speed of 100 r.p.m., or one scale division per r.p.m.

EXHAUST-GAS analyzers have come to be widely used in motor tune-up work, and a critical experimental investigation of such analyzers was made at the Virginia Polytechnic Institute by J. L. Dilworth,



Calibration curves for the different types of instruments. Instruments A and B were of the thermal-conductivity type; C was of the hot-wire type, and D of the relative-density type.

who is now connected with the Pennsylvania State College. All tests were made on a single-cylinder, variable-compression test engine, in order to eliminate, or permit the control of, as many variables as possible. The several gas analyzers were all connected to a manifold attached to the exhaust pipe of the engine. During each run the analyzer readings were noted as nearly simultaneously as possible, and the true air-fuel ratio was determined by accurately measuring the air and fuel supplied to the carburetor during the test period.

Six instruments were tested: two of the thermal conductivity type, one of the hot-wire catalytic type, one of the relative-density type, and two employing the Orsat principle. While not all makes on the American market were tested, all of the general types of analyzer adapted to automotive service were included. Brief descriptions of the underlying principles of the different types were given in the paper.

Results were plotted on charts, with the measured fuel ratio along the axis of abscissas and the indicated fuel ratio along the axis of ordinates. Thus if the instruments were absolutely accurate, all observation points would fall on a straight line inclined at 45 deg. The chart reproduced herewith gives a rough comparison of the average accuracies of the several instruments. The observation points for any particular instrument naturally were scattered to a considerable extent, and the chart shows a median line drawn through the observation points for each instrument.

It will be seen from the graph that every instrument practically ceased to function when the mixture became leaner than 14:1. This is undoubtedly accounted for by the fact that the theoretical curves of both thermal conductivity and density break sharply, and reverse their direction slightly, at the chemically correct mixture ratio.

This shortcoming of the exhaust-gas analyzer is not as serious as might at first be supposed, because mixtures leaner than 14:1 are rarely used. However, it is quite conceivable that some well-intentioned mechanic, in an effort to secure greater gas mileage, might rely too much on his gas analyzer and set the carburetor to supply a dangerously lean mixture, completely unaware that the instrument will never read higher than about 14 to 1, even though the mixture ratio may be 16:1 or 17:1. He should, therefore, be familiar with this limitation of the instrument.

The thermal-conductivity and catalytic types are the lightest and most compact; they operate satisfactorily in any position, and they are little affected by a reasonable amount of vibration. The relative-density instrument, while ruggedly built, is comparatively large and heavy. Certain instruments of this type incorporate a humidifying chamber which is filled with water, and such an instrument must be operated in an upright position and without much bouncing. Ordinarily the motor used in this system requires more current than can be successfully supplied by dry cells, which necessitates the use of a storage battery if the instrument is to be used for road testing.

All exhaust gas analyzers are calibrated for regular commercial gasolines. Any fuel whose chemical composition differs appreciably from that of ordinary gasoline will necessitate a special calibration of the analyzer. It appeared from the results of the tests that, in general, exhaust gas analyzers are not precision instruments, being likely to err as much as one-half of one air-fuel ratio, even under favorable conditions.

LUBRICATION of severe-duty, and particularly Diesel, engines was the topic of a paper by G. J. McNab, W. C. Winning, B. G. Baldwin and F. L. Miller of Esso Laboratories, Research Division, Standard Oil Development Co. There are certain differences from the standpoint of lubrication between Diesel engines as a class and gasoline engines. The former (1) are more subject to ring sticking, (2) form greater quantities of sludge, and (3) are subject to somewhat higher than normal rates of wear. Bearing corrosion should perhaps be included as a fourth problem, since most Diesel engines are equipped with special-alloy

bearings, which are subject to chemical attack. All of these problems are also known to gasoline engines but, except for bearing corrosion, they are seldom major problems in automotive operation.

"Severe duty" or "heavy duty" conditions often make it impossible to obtain satisfactory performance with some Diesel engines on straight mineral oils for more than a limited time before troubles such as excessive sludge formation, ring sticking, piston scuffing or seizing, etc., occur. Even more than in the case of automotive engines, the tendency in the Diesel engine field recently has been to operate under the more severe conditions.

LT. COMMANDER MARSHALL M. DANA, U.S.N., said the U. S. Navy thoroughly appreciates the value of the Diesel engine as a source of power, not only for the propulsion of submarines (in which these engines are used exclusively), tugboats and other similar craft, as well as motorboats of all types and for all purposes, but has also ambitious projects for its wider use in the future. In addition, in all new construction, Diesel engines supply ship's auxiliary power and drive different types of electric generators, such as for radio and for automatically controlled emergency units.

The existing emergency, said Commander Dana, makes very severe demands on the capacity of manufacturers which have been supplying Diesel engines for the Navy under normal conditions, and it becomes necessary to attract other engine builders whose production facilities are not yet fully utilized.

Reliability of performance is the prime requisite of every naval propelling plant, but the weight of the plant is not a reliable yardstick to appraise it by. On this point Admiral S. M. Robinson, Chief of the Bureau of Ships, said:

"The modern Diesel engine, weighing less than one-third of the engine used in the World War, has to its credit such reliability of performance in submarine service that today it may be considered fully equal to any other propelling plant of similar characteristics."

In rating engines, the Navy makes use of the term "specific volume," V_v , in cu. in. per brake horsepower. $V_v = (A \times L)/P$, where A is the area of all of the working cylinders in sq. in.; L , the stroke of the working piston in in., and P , the brake horsepower of engine. For four-cycle engines $V_v = (P \times N)/792,000$, and for two-cycle engines, $V_v = (P \times N)/396,000$. By plotting the values of b.m.e.p. and specific volume for each given value of r.p.m., a family of hyperbolae results. Each engine can be represented on this diagram by one point which completely identifies it as to cycle, b.m.e.p., r.p.m. and specific volume, as well as to its standing relative to other engines.

The author said the factor which most influenced the development of Diesel engines for the Navy was the success achieved with indirect drives, that is, electric and gear drives. Once the speed of the Diesel engine was divorced from the limitations imposed by the propeller speed, each of these two could be set independently and with due regard only to the factors controlling it. In this respect the Diesel-engine development followed that of the geared steam turbine.

BUSINESS IN BRIEF

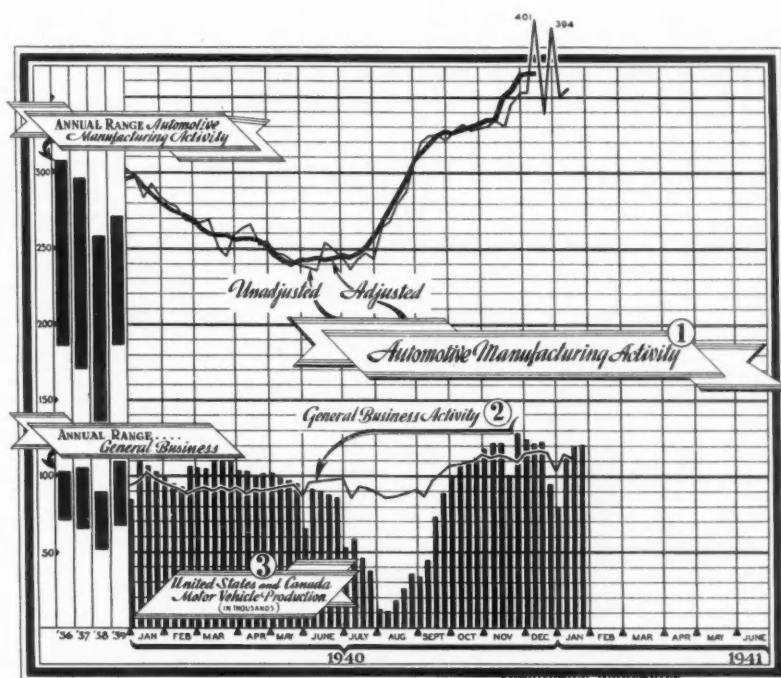
*Our own view of automotive production and sales;
authoritative interpretation of general conditions*

PICKING up impetus at the end of the month, production set a new record for January with an estimated output of 505,000 units, a considerable gain over the 449,492 vehicles produced in January, 1940, which stood as the previous mark for the month. Cancellation of the New York Automobile Show by the A.M.A. did not affect manufacturers, who appear to have adopted a policy of "making hay while the sun shines" before any possible priorities in raw materials or labor curtail their activities.

Introduction of new body styles and engine changes in several lines of cars within the next six weeks are expected to further increase sales, especially when the spring buying rush gets under way. Buick initiated this trend with its new lower priced model which it introduced late in January. However, cancellation of the New York show is not to be construed as indicating there will be no 1942 models. In announcing the show cancellation, Alvan Macauley, president of the A.M.A., said that model changes are to be expected where they will not interfere with the defense program.

Production advanced to approximately 121,000 units for the week ending Jan. 25, which is not far below the 1940 peak. General Motors turned out 50,900 vehicles, while Chrysler divisions accounted for 28,300 cars and trucks. Ford assembled 25,600 units. Stude-

¹ 1923 average = 100; ² Prepared by Administrative and Research Corp. New York. 1926 = 100; ³ Estimated at the Detroit office of AUTOMOTIVE INDUSTRIES.



**Weekly indexes of automotive general business
charted**

January Makes a New Production Record

commercial vehicle sales of 60,728 units were the largest for any month during 1940 and 47 per cent greater than the previous December.

U. S. passenger car retail sales of 3,461,791 vehicles during 1940 were 27 per cent above the 1939 total, while the year's truck sales of 632,563 units showed a 22 per cent advance over 1939. Studebaker enjoyed its biggest year since 1928 with consumer sales of 106,157 cars and trucks, 16 per cent greater than 1939. Chrysler division also set a new sales mark for the period since it has been concentrating on sixes and eights, surpassing 1937.

Retail sales for the first 10 days of January continued strong, with Chevrolet and Oldsmobile reporting new records for that period. Olds registered a 45 per cent gain over the same period of 1939, while Chevrolet deliveries were up 29 per cent. Pontiac and Buick had gains of 23 and 19 per cent, respectively.

baker was back at the top of the independents, followed by Nash, Hudson, Packard and Willys. Production was expected to dip slightly at the end of the month as manufacturers adjusted their field stocks to demand.

Retail sales in the U. S. of 4,094,354 vehicles during 1940, according to the A. M. A., were the third largest in the last 10 years, exceeded only by 1936 and 1937. December retail sales of 378,017 units were 20 per cent greater than December, 1939, and only slightly below November's total. December

IN TURNING cast iron with cemented-carbide tools, the use of a coolant is not essential and may be dispensed with altogether, but when steels are being turned with such tools, coolant is used in practically every case. The coolant acts as a lubricant between the chip and the tool, and it also quenches the chip, thereby making it more brittle and easier to break. This latter function is of particular importance with carbide tools, as a chip having a velocity of several hundred feet a minute can do much damage if not quickly broken. While steel can be cut with carbide tools without coolants, the life between grinds is greatly increased when coolants are used.

Machine tools designed to use cemented carbide tools should have adequate coolant-reservoir, coolant-piping, and coolant-pump capacities. Owing to the much higher speeds at which machines can be operated when cutting steel with such material as Carboloy, increased coolant capacity and flow are required. Adequate reservoir capacity is necessary so that the coolant itself will remain cool enough to produce the desired effect, and adequate pump and pipe capacity ensures that the coolant will leave the nozzle under sufficient pressure to force it against the tool and the work.

In conventional machine-shop practice, coolant is allowed to flow out of a pipe or nozzle over the work, "rolling" down over the tool. At the cutting speeds possible with cemented carbide tools, if the coolant were applied in this manner it would be carried away from the cutting edge by the fast-moving chip, so that its lubricating effect would be reduced and might be lost entirely. Besides, if the tool is not properly cooled, when it comes out of the work after the cut, the extremely hot cutting edge is suddenly struck and chilled by the coolant.

The most effective method of applying coolant when cutting steel with carbides is through pipes of approximately $\frac{3}{8}$ -in. diameter, directed in one of the following manners:

1. Pipe the coolant from beneath the tool. In this case increased secondary clearance should be provided to facilitate coolant reaching cutting edge. (Fig. 1)
2. Pipe the coolant from EACH side of the tool. (Fig. 2)
3. Drill the tool block to form a passage for the coolant through the block, thus permitting an unobstructed flow to the nose of the tool. (Fig. 3)

For best chip control and cooling action, the coolant in each case should be forced against the work at the tool tip with some pressure.

As to types of coolants to be used, the chief requirement is that they have good cooling qualities. A good soluble oil works well. Here the water is used for the cooling action, while the oil emulsified with it provides the necessary lubricating qualities and rust prevention.

Cutting oils are used in some cases, but have been found objectionable at times from the standpoint of the smoke developed. Furthermore, straight cutting

MEN and MACHINES

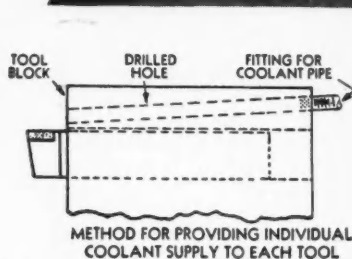
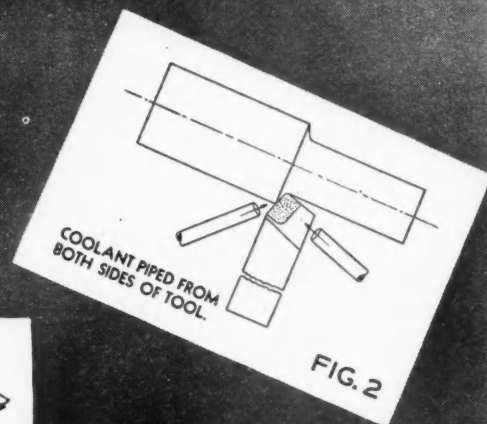
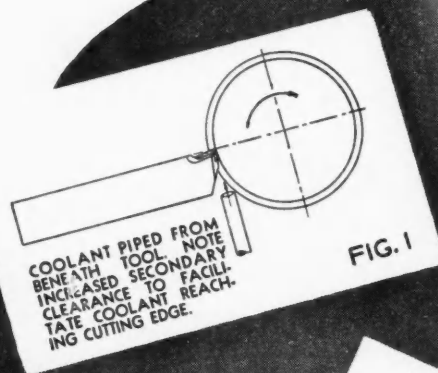


FIG. 3

METHOD FOR PROVIDING INDIVIDUAL COOLANT SUPPLY TO EACH TOOL

oils are not usually good coolants at speeds of 200 ft. per minute or greater.

KENT-OWENS MACHINE COMPANY, Toledo, Ohio, offers a new milling machine, No. 2-20, with hydraulic feed for the table. The table is 42 in. long by 12 in. wide and has 20 in. travel; its cycle is fully automatic. It can be fed or rapid-traversed in either direction, automatically shifted from rapid traverse to feed in either direction, and automatically reversed at both ends of the stroke. It may be automatically stopped at any point in its travel.

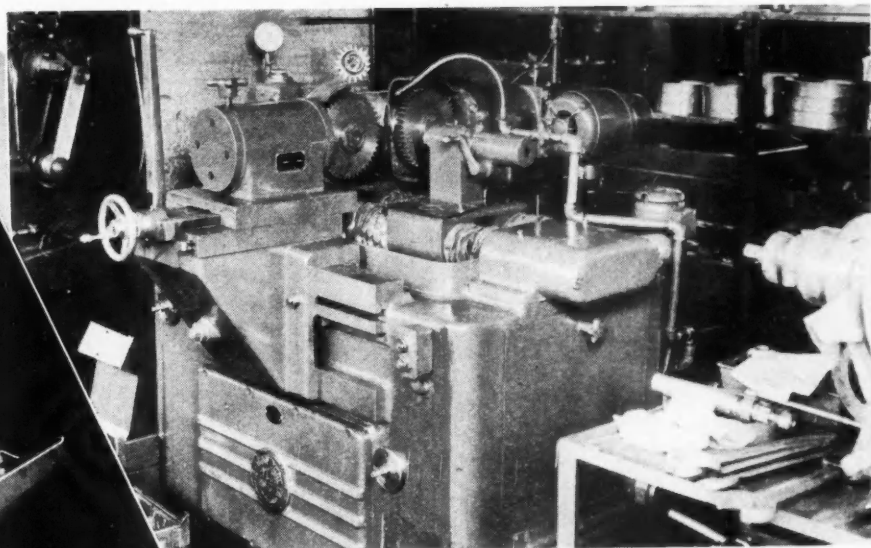
Feed rates for opposite directions of table travel are independently adjustable, which makes possible doing one operation at one end of the table and an entirely different operation at the other end. Any one of three spindle-speed ranges can be furnished. A medium range of 64 to 860 r.p.m. is

standard equipment, and in addition to it there are available a low range of 32 to 426 and a high range of 96 to 1284 r.p.m. Wide-faced, quiet-running pick-off gears are spline mounted and are easily removed for making spindle-speed changes. They are enclosed in an aluminum cover and run in a bath of oil.

The head is mounted on two cylindrical ground steel posts with the spindle midway between them. This gives a balanced design and eliminates overhang and cocking action. Regardless of the direction of forces on the cutter, the full projected area of the two steel posts resist these forces.

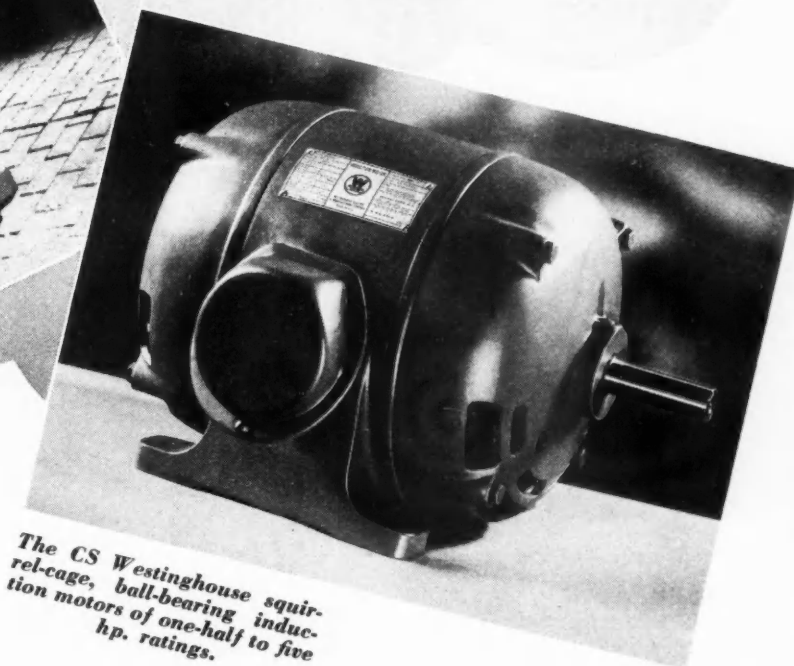
The spindle is driven by a motor mounted at the rear of the machine and the hydraulic pump by a separate motor enclosed in the base. Both are stand-

(Turn to page 140, please)



Kent-Owens No. 2-20 milling machine has hydraulic feed for the 42 in. table

(Upper right) Michigan gear lapping machine is automatic in operation



The CS Westinghouse squirrel-cage, ball-bearing induction motors of one-half to five hp. ratings.

Statistical Method of

UNDER the impetus of the national defense program, last November the War Department requested the American Standards Association to develop a project on the application of statistical methods to the control of materials and manufactured products. This resulted in the immediate formation of a special committee which unanimously reported as follows:

1. That a project on the subject be initiated under ASA procedure.
2. That the project be handled by the sectional committee method.
3. That the sectional committee be an autonomous one.
4. That the scope of the project be—the establishment of methods, means and practices for the use of statistics in controlling and improving quality.

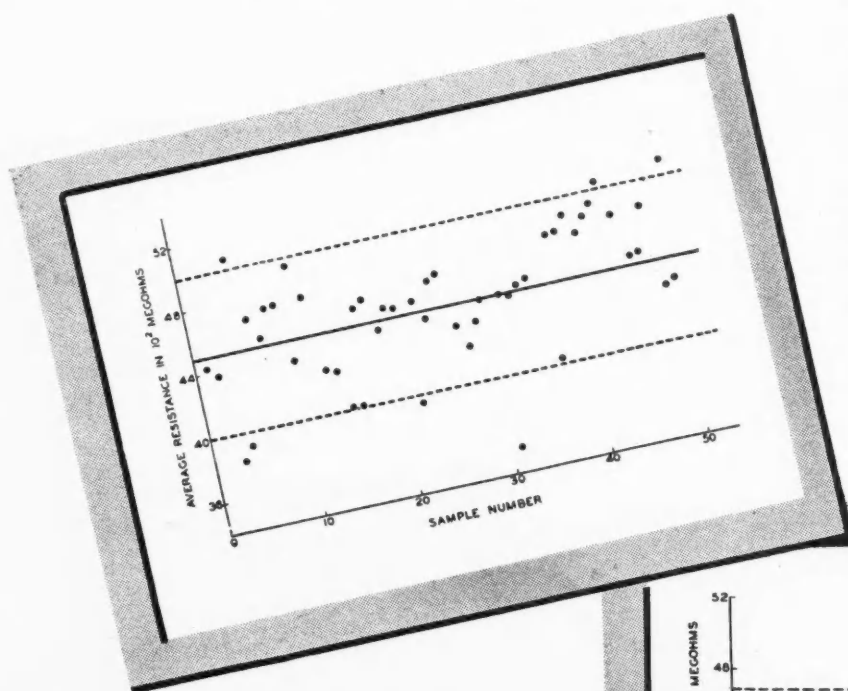
Thus the national defense program has served to focus attention upon one of the most powerful tools

available to management, one which has sought recognition for over ten years. It is hoped that through the medium of the ASA, the project will result in the development of simple but authoritative ground rules of practical value to industrial establishments, leading to a general acceptance in all industry.

Because statistical method rests upon a background of advanced and formal mathematics, it has been looked upon with askance by practical men while even the engineers have been reluctant to give it the consideration it deserves. Nevertheless, the ASTM investigated the method some eight years ago and in 1933 published a manual (1) which has influenced the work of the Society and of many of its members. The use of probability curves for the presentation of data will be found in the 1940 Edition of the S.A.E. Handbook, dealing with the physical properties of S.A.E. 3130 and 6130 steels.

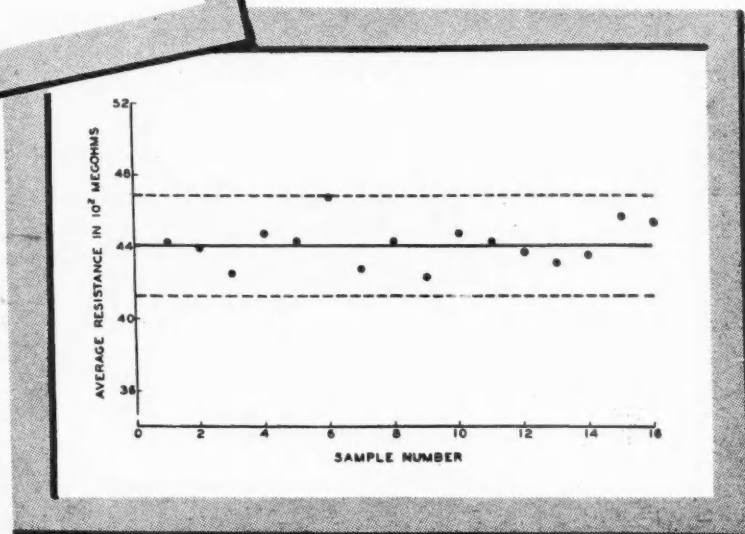
Actually, statistical methods have been employed in mass production for at least ten years in the manufacturing establishments of the Western Electric Co. A report (2) on the experience at General Electric was given by R. E. Wareham at the 1940 Annual Meeting of the A.S.M.E.

One of the most important applications of the statistical method is found in the control and inspection of products whose characteristics can be determined only by destructive testing. In this field, Leslie E. Simon, Captain, Ordnance Department, U. S. A., has developed a simple sampling procedure which assures



(Above) A practical application of the control chart shows 51 averages of four resistance measurements each, made on 204 pieces. Several of the measurements exceed the control limits, suggesting the presence of assignable causes of variability and consequent lack of control in the manufacturing process.

(Right) On the basis of lack of control indicated in Fig. 1, certain causes of variability were isolated and removed. It should be noted that the new data stay within the control limits, indicating that a state of statistical control has been attained. Incidentally, note that the new limits are more narrow than the ones originally established for Fig. 1.

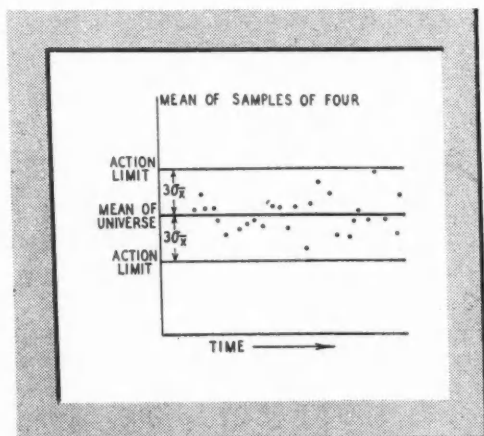


Quality Control

the quality of gunpowder, fuses, and other ordnance products. It is obvious that 100 per cent inspection of ordnance materials is feasible only on the battle field; and equally obvious that any method of inspection by small samples assuring practical perfection should be worth vast sums of money to the Government.

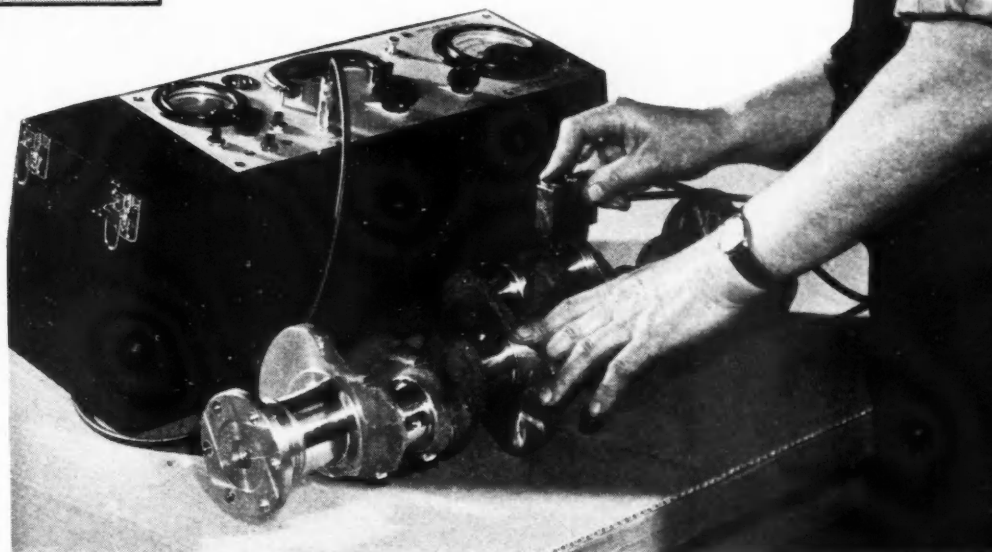
Since management is interested primarily in economy of operation, let us forget for the moment the mathematical background and look at the following advantages claimed for quality control based on the statistical method:

1. Greater uniformity of product.
2. Larger volume at no increase in cost.
3. Reduction in the cost of inspection.
4. Detection of trouble in production.
5. Avoidance of trouble by anticipating changes in quality.
6. An authentic record of the quality of a product.



(Above) General form of control chart for constant conditions, with "action" limits equal to plus or minus three times the standard deviation from the mean.

Studebaker uses the Abbott Profilometer for checking the surface finish of crankshaft pins and journals.



Does it not follow that any method or process which promises to yield even a few of these economies is well worth considering? We asked this question of a group of important producers in the automotive field and received a positive response, leading to the formation by the writer of a special industry group organized for the purpose of studying the statistical method in more detail. As a matter of fact, this initial effort has led to a request to organize a more formal association designed to give inspectors and quality control executives a professional standing through participation in a technical society.

The next point to consider is just where statistical method can be applied in a practical sense. Here are a few representative applications:

1. For the acceptance of raw materials.

2. For mutual customer acceptance of finished products.

3. For control of process and acceptance of products requiring destructive

(Turn to page 139)

Production Lines . . .

Metals Control

At the meeting of the Institute of Mathematical Statistics in Chicago, December, 1940, two leading metallurgists demonstrated the value of the statistical method as applied to metallurgical problems. R. B. Mears of the Aluminum Co. of America, presented a paper entitled, "The Application of Statistics to Metallurgical Problems," dealing primarily with research and development activities. On the other hand, E. M. Schrock, supervisor, statistical division, Jones & Laughlin Steel Corp., described an application to actual production control in a paper entitled, "The Place of Statistical Analysis in Ferrous Metallurgy." Space does not permit an extended abstracting of either of these interesting papers. But we commend them to the attention of engineers and metallurgists as being worthy of searching study. As time goes on, we believe that applications of the statistical method will be found invaluable in much of the research work in our industry. We shall be glad to put you in touch with the men mentioned above or with other workers in this field, if you are interested.

Thin Babbitts

Apropos our article on thin babbitt bearings which appeared in *AUTOMOTIVE INDUSTRIES*, Jan. 1, 1940, we have an interesting letter from K. K. Karpinski of Chrysler Corp., outlining some of the pioneering work along this line that had been done by Chrysler research. A comprehensive discussion of the development and testing of thin babbitt bearings is found in a paper entitled, "A Recent Development in Engine Bearings," which was presented by Mr. Karpinski before the Kansas City Section, S.A.E., April 18, 1940. We hope that those interested in this subject have had a copy of the paper or will get in touch with the author for a copy. Incidentally, we shall appreciate it a lot if other research workers will keep us in touch with current studies which merit attention in your publication.

Metal Cutting

Second edition of the excellent treatise entitled, "Practice in Machining Zinc Alloy Die Castings" issued by the New Jersey Zinc Co., is off the press. The new booklet is greatly enlarged and contains many illustrations of practical fixtures, drawings of tool

forms, and other information useful to the factory executive and tool designer. Among the many topics covered are: broaching and shaving, bending and forming, drilling, facing, milling, riveting, turning and boring, spinning, etc. It might be well to observe that one of the principal advantages of the die casting process is the ability to produce parts which require but little machining. Nevertheless, zinc alloy die castings have good machinability and can be handled with facility in all manner of metal cutting operations. One of the functions of the booklet is to provide the user of die castings with special information concerning the best tool forms, most suitable cutting fluids, and other specialized information designed to facilitate the economical handling of the zinc alloy parts. Ask us for your copy.

Balances Props

An organization now marketing an electronic type of auto-wheel balancing equipment has developed an adaptation of the device for checking propeller balance directly in an airplane. This equipment will not be commercially available for another sixty days. In the present stage of development, the special vibration pick-up instrument is mounted directly on the engine, the feeble current generated in this unit is carried to an electronic amplifier which operates a stroboscopic lamp. An indicating instrument shows the amount of unbalance. Although this equipment is not yet commercially available, if you are interested we shall be glad to put you in touch with the manufacturer.

National Defense

Marmon-Herrington, a progressive organization which started modestly under the capable direction of Art Herrington, is undergoing a major expansion program and bids fair to become a major factor in the production of specialized military equipment. You can look for a progress report in the near future.

Cylindrical Fits

Writing in *Industrial Standardization*, January, 1941, John Gaillard reopens the question of an international standard for cylindrical fits. Fundamental problem is the matter of whether to adopt the basic hole or the basic shaft system—or maybe both. Suggestions from industry will be appreciated—J. G.

NEWS OF THE INDUSTRY

30-Day Strike Notice Invoked in Michigan

State Labor Mediation Board Seeks To Prevent Wildcat Strikes in Interest of Defense Work

With employment near 1937 levels due to national defense activity, an outbreak of strikes and strike threats swept Michigan factories in January, necessitating the presence of federal conciliators in the state and a ruling by the State Labor Mediation Board that a 30-day notice must be filed prior to calling a strike rather than the usual five-day notice. Because strikes in plants doing national defense work were deemed not to be "in the public interest," the 30-day clause was invoked by the board. This longer waiting period is required in public utilities and similar industries. Leaders of organized labor in the state opposed the interpretation, which was upheld by Attorney General Herbert J. Rushton.

A strike in the Wilcox-Rich Division plant of the Eaton Mfg. Co., at Saginaw, which manufactures airplane valves and other aircraft parts, was averted Jan. 15 when James F. Dewey,

federal conciliator, arranged a settlement on orders of the National Defense Advisory Commission. The next day the NLRB in Washington denied a petition of the UAW-CIO to end this jurisdictional dispute with the UAW-AFL by holding a plant election. Eaton had signed a two-year sole collective bargaining contract May 16, 1940, with the

UAW-AFL covering the Saginaw plant and the NLRB upheld this pact.

The UAW-CIO had picketed the plant beginning Nov. 12 and then threatened a strike in five other Eaton plants but this was averted Dec. 17 when an agreement was reached under which the UAW-CIO understood that 300 strikers would be returned to their jobs. Alleging that only 60 of the workers had been rehired, the UAW-CIO resumed picketing Jan. 13 and a riot ensued between workers and Saginaw police when the morning shift endeavored to enter the plant. Twenty-five UAW-CIO members were jailed, five policemen were hospitalized and Gov. Murray D.

(Turn to Page 138, Please)

The Brass-Hat Rack



"I guess it's just one of those days . . . !"

The Show Is Off

Following a meeting of the board of directors of the Automobile Manufacturers Association, the following statement was issued by Alvan Macauley, president:

"We have cancelled the National Automobile Show, which normally would have been held in New York City in October, except for the defense situation.

"This step was taken today after consulting all car producing companies in the industry, and reviewing the status of defense work undertaken in this industry.

"We believe the public will approve the industry's decision to eliminate the show in a period such as this. The action will not control the course each company may follow as to introducing new models for 1942. Some model changes may be expected, where they will not interfere with the defense program, because it has been possible in many cases to keep tool and die departments going with this work pending readiness of their defense assignments. Changes also may be advisable or necessary on account of needed defense materials. Each company gave its pledge to our Government last October 15 that future model changes would be subordinated to defense work."

The New "Line-Up" in the OPM Production Division

Raw Materials and Production Divisions Merged Plan to Distribute Contracts Widely Intensified

Headed by John D. Biggers, the recently organized Office of Production Management of the National Defense Advisory Commission has transferred the functions of the Raw Materials and Production Divisions to a new Production Division. Mr. Biggers, president of the Libbey-Owens-Ford Glass Co., thus has been given jurisdiction over the two merged old divisions. Formerly William S. Knudsen, OPM director general, was head of the Production Division while Edward R. Stettinius, Jr., was in charge of the Raw Materials Division. Mr. Stettinius, a member of the NDAC, has been made Director of Priorities.

Other changes indicated as a result of the shake-up in defense machinery will be the establishment of a production planning board, an intensification of the program to distribute defense contracts more widely, and an extensive expansion of personnel under the OPM.

Mr. Biggers announced these developments at a press conference on Jan. 18, when he made his debut as director of the new production division. He indicated that the OPM's responsibilities go beyond the job the defense commission had to do as a purely advisory body, and that it is no longer the aim of Mr. Knudsen to keep the agency's personnel to a minimum.

Mr. Biggers announced that his deputy director will be William L. Batt, president of SKF Industries, who for the past seven months has been acting as deputy commissioner of the defense commission's industrial materials division. Other divisions and their chiefs established under Mr. Biggers' production division include:

Industrial Materials—W. Averell Harriman, chief, on leave as board chairman, Union Pacific Railroad, and former liaison officer of the commission's industrial materials division. Mr. Harriman's staff will include:

George M. Moffett, chief, mining and mineral products. Mr. Moffett is on leave as president of the Corn Products Refining Co., and was former director of the food products section of the production division.

R. R. Deupree, chief, agriculture and forest products. Mr. Deupree, on leave as president of Procter & Gamble Co., was former division executive of the agriculture and forest products division.

E. R. Weidlein, chief, chemicals, drugs, and allied products. Mr. Weidlein, on leave as director of the Mellon Institute, was former division executive of the chemicals and allied products of the industrial materials division.

Aircraft, Ordnance, and Tools—E. F. Johnson, retired, former vice-president, General Motors Corp., and former director of the light ordnance section of the production division. Mr. Johnson's staff will include:

Merrill C. Meigs, chief, aircraft. On leave as publisher of the Chicago Herald-American, Mr. Meigs was former director of the aeronautical section of the production division.

A. R. Glancy, chief ordnance. Formerly president of Pontiac Motor Co., Mr. Glancy has been special adviser on ordnance work in the production division; and

Mason Britton, chief, tools. Mr. Britton, on leave as vice-chairman of McGraw-Hill Publishing Co., was former director of the machine tool section of the production division.

Ships, Construction and Supplies—W. H. Harrison, chief, is on leave as vice-president and chief engineer of the American Telephone & Telegraph Co. He formerly was chief of the construction section of the production division. His staff heads include:

Emory S. Land, chief, ships. Chairman of the Maritime Commission. Admiral Land has been director of the shipbuilding section of the production division.

J. C. Nichols, chief, supplies. Mr. Nichols, on leave from J. C. Nichols Investment Co., Kansas City, was former director of the miscellaneous equipment section of the production division.

The production planning board, to be a completely new organization, will have the job of surveying what the defense commission has accomplished during the past seven months. To be composed of an undetermined number of members, the new board will launch its study in terms of future requirements and will develop plans for improving the first effort, Mr. Biggers said.

Among other things the new planning board may determine the necessity for industrial advisory committees although Mr. Biggers cautioned that no definite steps have been made in that direction. One subject still shrouded in uncertainty is the status of the labor division, which, under the defense commission set-up, was under the direction of Sidney Hillman, commission member who is now OPM associate director general. Whether the labor division will

remain as a unit of the defense commission or given more prominence as a division of OPM, and whether labor advisory committees will be established simultaneously with the creation of industrial advisory committees are subjects still to be decided upon.

Asked about production of tanks and planes, Mr. Biggers reported that production of 13-ton tanks is more than four months ahead of schedule; that the 26-ton tanks are not being produced in volume because of the tremendous tooling job and because new plants are still in the construction stage. He estimated January plane production at 900 units, expressing uncertainty that production would reach that figure.

Automotive Companies Get Government Loans

Six automobile manufacturing companies have received commitments for defense loans from the Defense Plant Corporation, RFC subsidiary, and from the Reconstruction Finance Corp. itself, aggregating \$96,218,280, according to a tabulation furnished the White House and Congress by Federal Loan Administrator Jesse H. Jones.

The companies receiving loans from the Defense Loan Corp., the amounts involved, and the purposes for which they are to be used, follow:

General Motors Corp., Detroit, \$32,000,000 for building and equipping plant and buying machinery for the manufacture of airplane motors.

Graham-Paige Motors Corp., Detroit, \$1,-803,280 for machinery to manufacture aircraft engine parts.

Packard Motor Car Co., Detroit, \$2,504,-611 for building and equipping plant and buying machinery for manufacturing extruded products for the manufacture of aircraft.

Studebaker Corp., Chicago, \$50,000,000 for building and equipping plant and buying machinery for manufacture and furnishing of aircraft engines and parts.

Willys-Overland Motors, Inc., Toledo, \$1,-700,000 for machinery, equipment and facilities for making 155 mm. shells.

Defense Plant Corp., Mr. Jones re-



International

Navy's New Fighter Plane

Shown in flight is the Vought-Sikorsky XF4U-1 pursuit plane built for the U. S. Navy. According to aviation experts it is the fastest fighter plane developed in any country and is capable of over 400 m.p.h. The peculiar wing design is said to reduce drag nearly 50 per cent.

ported, has made commitments aggregating \$349,779,683 to all manufacturers. Of this amount, \$283,206,197 is for the construction of plants and the acquisition of machinery and equipment for the manufacture of airplanes and parts. These plants and equipment are owned by the RFC subsidiary and leased to the manufacturer. Of the total, \$35,550,000 is for machine tools.

Commitments for national defense made direct by the RFC went to these companies:

Graham-Paige Motors Corp., Detroit, \$1,280,000 for working capital, burden, machinery and tools, miscellaneous to complete Army and Navy contracts for firing pins, connecting rods, breech housing, cartridge guide plates, and operating levers.

American Bantam Car Co., Butler, Pa., \$1,300,000 for working capital, machinery and equipment to complete contracts for manufacturing Army reconnaissance cars; \$10,000 for additional working capital; and \$125,000 for working capital for production of reconnaissance cars.

Plant Extensions and Factory Enlargements

Ampco Metal, Inc., Milwaukee, Wis., manufacturers of Ampco metal and other aluminum bronze alloys, has signed a contract for a new foundry addition. The new structure will be 164 by 310 ft., double-deck in part, and will contain 76,620 sq. ft. of working space. The cost will be \$140,000 exclusive of equipment.

National Airplane & Motor Co. has completed plans to move its manufacturing activities from Billings, Mont., to Los Angeles, Calif.

Reed-Prentice Corp., Worcester, Mass., has contracted for plant expansion of building and machinery at a cost of \$400,000 in order to double the capacity of its production of engine and tool-room lathes.

McCullough Engineering Co., Milwaukee, Wis., in the near future will move into its new and larger plant, which is now under construction. This company supplies superchargers to the leading commercial Diesel engine builders and also makes Roots type superchargers for pressurizing military airplane cabins.

Hammond Machinery Builders, Inc., Kalamazoo, Mich., manufacturers of grinding and polishing machinery, is now using its new plant addition that makes available more than double the former manufacturing space. The addition also houses a modern engineering office, demonstration room, recreation room and a processing room.

Within the next 30 days Thompson Products, Inc., of Cleveland, Ohio, will begin construction of a completely new manufacturing unit costing over \$11,000,000. The new plant will operate under the name of Thompson Aircraft Products Co. The annual capacity of aircraft valves and parts will amount to about \$22,000,000 with a possible maximum of \$30,000,000. Plans call for a floor space of 575,000 sq. ft., or approximately 13 acres. The new plant will be located on a 100-acre tract in Euclid, Ohio, near Cleveland, and will



Acme

Truck Fleet for Burma Road

This new fleet of trailmobiles, assembled at Rangoon, India, will stimulate the flow of vital goods along the Burma Road, lifeline of the Chinese government at Chungking. It was delivered recently to the Chiang government.

have a working force of about 5000 employees.

To meet national defense requirements, expansion plans of Aluminum Co. of America call for an expenditure of \$150,000,000 within a two-year period, for the most part in southern states. When the expansion program is completed, its annual aluminum production is expected to reach 700,000,000 pounds as compared with 327,000,000 pounds produced in 1939.

Bohn Aluminum & Brass Corp., Detroit, now has under way an expansion program amounting to about \$3,100,000, including \$2,200,000 in new equipment and \$900,000 in new buildings. When completed employment will be increased by 3,000 workers and the annual payroll by about \$5,000,000.

Navy Buys Fruehauf Trailers

According to an announcement by President Harvey C. Fruehauf, the Fruehauf Trailer Co., Detroit, will shortly begin production on special drop frame van type semi-trailers for the Aeronautics Division of the U. S. Navy. The initial order calls for 27 trailers, which are to be 26 feet in length.



Conventions and Meetings

American Management Association, Annual Personnel Conference, Chicago,	Feb. 12-14
Chamber of Commerce of the U.S.A., Washington, D. C.	Apr. 29-May 1
Western Metal Exposition and Congress, Los Angeles, Calif.	May 19-23
Shows	
Chicago Motor Salon, Chicago.	Feb. 1-9
Southwest Automotive Show, Fort Worth, Tex.	Feb. 6-9
National Automobile Trailer Show, Chicago	Feb. 22-Mar. 2
Machine & Tool Progress Exhibition, Detroit	Mar. 24-29

10,419 More Dodge Trucks Ordered by U. S. Army

A new order for 10,419 specially designed U. S. Army Dodge trucks has been received by Chrysler Corp. through its Fargo division, R. L. Biggers, president of that division, announces. Orders received by the corporation for Army trucks in both its United States and Canadian plants during the last 12 months call for more than 57,700 units, at a total value of more than \$58,000,000.

Buick Aircraft Engine Factory Near Chicago

Buick's new aircraft engine plant will be located at Melrose Park, a Chicago suburb, according to an announcement by Harlow H. Curtice, company president. The factory, costing \$31,000,000, will have 1,000,000 square feet of floor space, sufficient to manufacture 500 Pratt & Whitney 14-cylinder engines monthly. The cost of tooling the plant is estimated at \$24,000,000. When in full operation, 10,000 workers will be employed, including 200 supervisory employees to be transferred from the Buick plant at Flint.

Increase Bessemer Steel Production

Three large steel companies have been licensed by Jones & Laughlin Steel Corp. to use its Bessemer flame control method to increase steel production without actually constructing additional producing units. They are the Republic Steel Corp., Cleveland, Ohio; Youngstown Sheet & Tube Co., Youngstown, Ohio; and the Wheeling Steel Corp., Wheeling, W. Va. In addition, the Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., has been licensed.

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE INDUSTRIES

Business activity has resumed its upward trend after the temporary recession due to the holidays. The seasonally adjusted index of The New York Times for the week ended Jan. 4 stands at 123 per cent of the estimated normal as against 121.1 a week earlier and 113.3 a year ago. The unadjusted index of The Journal of Commerce for the week ended Jan. 11 stands at a preliminary figure of 114.5 per cent of the 1927-29 average, as compared with 106.2 for the preceding week and 104.1 for the similar period of last year.

Department store sales during the week ended Jan. 11, according to the Federal Reserve compilation, were 16 per cent greater than those in the corresponding period of 1940. This gain compares with one of 4 per cent a week earlier. Sales for the four weeks ended Jan. 11 were 17 per cent above those a year ago.

Railway freight loadings increased more than seasonally during the week ended Jan. 11, totaling 711,675 cars as against 614,171 cars in the preceding week and 668,241 cars in the comparable period last year. The Shippers' Advisory Boards estimate that loadings in the first quarter of the year will be about 9.5 per cent above actual loadings in the first three months of 1940.

Electric power production for the week ended Jan. 11 was 9.3 per cent greater than a year ago. This rise compares with one of 9.4 per cent for the preceding week.

Bank debits to deposit accounts, except inter-bank accounts, in leading cities for the week ended Jan. 8 were

27 per cent larger than a year ago. The total for the thirteen weeks ended on that date is 9 per cent above that a year earlier.

Commercial and industrial failures during the week ended Jan. 9, according to Dun & Bradstreet, numbered 262 as against 179 in the preceding week (which contained a holiday) and 277 in the corresponding period last year.

Crude oil production for the week ended Jan. 11 averaged 3,364,450 barrels daily, showing a decline of 2,750 barrels from the average for the preceding week and remaining considerably below the level of current requirements, estimated by the Bureau of Mines at 3,591,000 barrels daily.

Bituminous coal production for the same period is estimated at 10,150,000 net tons, as against 8,775,000 tons in the preceding week and 10,005,000 tons in the corresponding period last year.

Professor Fisher's index of wholesale commodity prices for Jan. 11 stands at 85.8 per cent of the 1926 average as against 85.4 a week earlier and 85.2 two weeks earlier. The weekly index of the Bureau of Labor Statistics for the same date is unchanged at 80.2 as compared with 79.9 two weeks before and 79.5 a year ago.

Member bank reserve balances rose \$130,000,000 during the week ended Jan. 15, mainly as the result of a seasonal decline of \$86,000,000 in the amount of money in circulation. An unusually small increase of \$32,000,000 in the monetary gold stock occurred during the week. Excess reserves rose to \$6,900,000,000, only slightly below the record figure.

Dealers Consider Local Auto Shows

Car dealers of New York City, it is understood, may consider sponsoring the New York Show as they have on one or two occasions in the past decade. Harry Bragg, manager of the Automobile Merchants of New York, said at press time, that dealers in the metropolitan area have not had time to discuss the matter, but would undoubtedly study the possibilities of a dealer-sponsored show and announce their decision later. Chicago dealers will sponsor the showing in Chicago again this year, it has been announced. Detroit dealers have deferred their decision until a later date.

Wright Engine Output

Production of Wright airplane engines by the Wright Aeronautical Corporation, of Paterson, N. J., is now exceeding 1,000,000 hp. monthly for national defense, according to Guy W. Vaughan, president of Curtiss-Wright Corp. Production space will have been expanded from one plant of 900,000 square feet two years ago to five plants having 2,842,000 square feet of manufacturing area by late this spring. By

mid-summer, another new factory of 2,100,000 square feet will be completed near Cincinnati, O. Employment in the Wright company has risen in the two-year period from 6,631 to 15,346 persons, and will be increased to more than 30,000 workers when the current expansion program is completed.

Foresee Early Speed of Machine Tool Supplies

At his press conference on Jan. 23, W. S. Knudsen, director general of OPM, said that of the 799 military planes produced last December, about 60 per cent or 480 were combat types and 40 per cent were training ships. During the same month 2400 airplane engines of all types were manufactured.

The largest job in the way of machine tool supplies, it was stated, will be "over the hill" by April or May. Part of the tooling-up is now completed.

According to Mr. Knudsen regarding supplies of materials:

Steel—So far there have been adequate supplies. Report on capacity by Gano Dunn, president, J. G. White Engineering Co., will be submitted to White House soon. If expansion in addition to that made and under construction is necessary the steel industry will build

it, it was stated by Mr. Knudsen.

Aluminum—President Davis of Aluminum Co. of America recently was in conference with Mr. Knudsen and decided on a course of procedure. Shortage of forging and bar capacity, which is being taken care of by J. D. Biggers, director of production.

Magnesium—The trouble is not so much the matter of supply of metal as it is a matter of foundry capacity. Foundry capacity is no cause for much worry because the operation is mostly one of sand casting so the principal need is to train more men. Airplane engine production is not expected to be delayed by magnesium shortage.

Zinc—Fear of shortage resulted in request that automobile manufacturers be sparing in the use of ornamental "hickeys," but there is no present trouble or existing need for new smelting capacity.

New Pontiac Sedan

A metropolitan torpedo sedan has been added to the de luxe models of the Pontiac line, according to a company announcement. It has a four-door body and is available with either a six or eight-cylinder motor. Prices have been announced at \$921 for the six and \$946 for the eight. All other models in the de luxe series are being continued during the current year.

A. E. A. Sponsors Educational Tour

Beginning Feb. 5 and ending May 13, the Automotive Electric Association will sponsor a nation-wide educational tour, which will include 34 principal cities. The purpose is to conduct sales and service meetings for the benefit of association members and associated automotive distributors and dealers in those trade centers. The eight participating manufacturers are as follows:

Bendix Products Division, American Bosch Corp., Briggs & Stratton Corp., Carter Carburetor Corp., Electric Auto-Lite Co., Sterling Cable Division, Trico Products Corp., and USL Battery Corp.

Bendix Aviation Corp. Holds Annual Election

At the annual election of the Bendix Aviation Corp., Vincent Bendix, A. C. Anderson, H. B. Baker, E. R. Breech, Paul H. Davis, S. G. Down, Charles Marcus, W. L. McGrath, C. O. Miniger, E. R. Palmer, and D. O. Thomas were reelected as directors for the ensuing year. Vincent Bendix was reelected president; Charles Marcus, vice-president in charge of aviation operations; D. O. Thomas, vice-president in charge of automotive operations; E. R. Palmer, vice-president in charge of finances; W. L. McGrath, R. P. Lansing and M. P. Ferguson, vice-presidents; H. A. Gossner, secretary; W. H. Houghton, comptroller.

MEN

C. A. Erickson, who has been connected with the Chicago plant of the United Specialties Company for several years, recently was appointed Detroit representative of the company's air cleaner division in that city.

W. S. Roberts, general manager of the Linden, N. J., Division of General Motors Corp., has been appointed vice-president and general manager of General Motors of Canada, Ltd. He succeeds **Harry J. Carmichael**, who resigned to accept a key position in Canada's war production program. **Otto J. Stanitzke**, assistant general manager of the Linden Division, has been advanced to the general manager position.

H. D. Wehrly is the manager of the newly consolidated marketing and organization department which will work with both the motor car and electric refrigeration divisions of the Nash-Kelvinator Corp.

C. W. Seiberling, co-founder of the Seiberling Rubber Company, Akron, O., was honored by employees and friends at a big birthday party in that city on January 24 in celebration of his 80th birthday anniversary.

John Shotwell, treasurer and a member of the board of directors of Willys-Overland Motors, Inc., Toledo, O., has resigned to accept a new position in the airplane industry in connection with the armament program.

L. D. Hunt has been elected president of the De Kalb Wagon Co., De Kalb, Ill.,

builder of commercial auto bodies. He succeeds his father, the late Seymour M. Hunt. **E. E. Miller** recently became general sales manager of the company.

J. W. Gardner, chairman of the executive committee of the board of directors of the Gardner-Denver Co., Quincy, Ill., was honored recently by his associates, who presented him with a tiny gold, diamond-set model of a steam governor in recognition of his 60 years of service with the company.

Sid G. Harris is now manager of the sales engineering department of the Petroleum Solvents Corp., New York City, for the fleet, industrial and marine division of the organization.

A. B. Nielsen has been appointed assistant sales manager of Packard Motor Car Co., succeeding **H. L. Beecroft**, who will become vice-president of sales in the Packard Motor Car Co. of New York.

R. P. Lansing and **M. P. Ferguson** have been elected vice-presidents of Bendix Aviation Corp.

Thomas E. Murray, of New York, has been elected a director of the Chrysler Corp., succeeding the late **Harry Bronner**.

Ray H. Morris, for the past eight years with Hardinge Brothers, Inc., Elmira, N. Y., has been elected vice-president of that company and will be in charge of its Hartford branch at West Hartford, Conn.

D. M. Allgood has been named director of merchandising of the Willard Storage Battery Co. He succeeds **S. E. Baldwin**, veteran of the Willard organization, who assumes the position of manager of public relations.

E. S. Chapman, who has been vice-president and assistant general manager of the Chrysler Corporation's Plymouth plant in

Detroit for the past five years, has been loaned by the corporation, at the request of the National Defense Commission, to serve on its staff.

William A. Wecker has been made president and general manager of McKinnon Industries, Ltd., St. Catharines, Ont., a subsidiary of General Motors of Canada.

D. A. Samson, formerly operating manager of the Dodge main plant in Detroit, has been appointed operating manager of the Chrysler Warren Avenue plant, which has been leased from the Graham Paige Motors Corp. He will have charge of supervising the production of parts for Army bombing planes.

Roy Jackson, formerly of the Steel Export Co., has been named administrative officer of OPM's administrative services division in Washington.

F. F. Schwilk and **Earl Ginn** have been elected vice presidents of Continental Motors Corp. Mr. Schwilk will continue in charge of sales and Mr. Ginn will have direction of automobile engineering. **H. M. Parker** has been named assistant treasurer and **James H. Ferry, Jr.**, has been elected to the vacancy on the board of directors caused by the death of his father.

A. J. Schamehorn, director of the GM Proving Ground at Milford, Mich., has been named to a manufacturing assignment at the Linden Division of the corporation. **Ernest E. Wilson** will succeed Mr. Schamehorn as the proving ground director.

Franklin W. Murray, Detroit, has been appointed Detroit sales representative by the Gemloid Corporation, Long Island, N. Y., manufacturers of plastics. **Lawrence H. Wilson**, industrial designer, will collaborate with him as stylist.

Flashback to SAE Annual Meeting in Detroit

(Top center) A.C.F. 12-ton tank at SAE military vehicle display.



(Upper left) Sir Louis Beale, of British Purchasing Commission, principal speaker at SAE banquet, Jan. 8.

(Lower left) Rear Admiral John H. Towers (left), chief of Bureau of Aeronautics, U. S. Navy; A. T. Colwell, vice-pres. Thompson Products, Inc., new president of SAE.

(Lower center) Brig.-Gen. Oliver P. Echols, Chief of Material Division, U. S. Army Air Corps.

(Lower right) C. C. Carlton (left), director of Automotive Committee for Air Defense; John A. C. Warner (standing), gen'l manager of SAE; Theodore P. Wright, vice-pres. & director of engineering, Curtiss-Wright.



Steel Market Pace Is Still Set by Automotive Demand

Revision of Capacity Figures May Indicate No Extension Required to Meet Defense Needs

Automobile manufacturers and parts makers continue to set the pace in the steel market with commitments for material needed for first and early second-quarter assemblies. This demand is apart from that for national defense contracts, in which alloy steel plates still play an important part. Hot rolled carbon bars have come in for heavy buying by automotive consumers in the last few weeks, and some of this business is for second-quarter delivery, although on some sizes mills are still able to promise late first-quarter shipments to regular customers. Sheet and strip steel business, heavy as it is, is taken care of by the mills in the routine way.

The estimate of the American Iron & Steel Institute of the rate of ingot capacity in operation for the week ending Jan. 25 established a new peak of 99.1 per cent, but the Institute's announcement that 1940 capacity figures would be published the next week caused many to think that the situation will not appear quite so tight, once the capacity that was added last year figures in the statistical picture. It is also pointed out that the rating of some of this new capacity may be exceeded in actual operation, at least in the case of some furnaces.

Progress has been made in bringing scrap steel quotations down, although the goal set by Leon Henderson of the National Defense Advisory Commission has not yet been fully attained. As further evidence of cooperation in efforts to keep steel prices on an even keel, the action of some pig iron producers, who refused to follow the example of others in raising the price, is pointed to, but the sales books of those adhering to the old price are pretty well filled. Delays in shipments on defense contracts have so far been avoided, and this supports the steel industry's contention that no additional capacity is required to do full justice to the defense program.

Although the sole producer of aluminum quotes the 99 per cent plus metal at 17 cents a pound, remelted metal, obtained from scrap, commands as high as 22 cents.

Tin importers look for no change in the price of Straits tin as a result of a 2½ cents export tax to be levied by the Federated Malay States. The market price at Singapore is likely to be adjusted downward, so as to equalize the price to the American consumer, which is predicated on the U. S. Government buying price of 50 cents. Of the 75,000 tons, which the Metals Reserve Company, with the approval of the Reconstruction Finance Corporation has arranged for with the Inter-

national Tin Committee, 34,930 tons have been actually purchased, and of this tonnage 14,225 tons remain to be shipped. The market continues quiet with spot Straits offered freely at 50.15 cents.—W. C. H.

Shift Studebaker Officials

As part of Studebaker's participation in national defense production and intensification of its passenger car and truck sales campaign, Paul G. Hoffman, president, has announced two shifts in executives. George D. Keller, vice-president in charge of sales, has been appointed assistant to H. S. Vance, chairman, who is directing Studebaker's defense manufacturing program. K. B. Elliott, vice-president and Mr. Hoffman's assistant for several years, has been named to succeed Mr. Keller.

Buick Adds Four Models To Series 40 Special

Addition of four new models to the Series 40 Special line of Buick passenger cars, having torpedo styled bodies, three-inch shorter wheelbase and six-inch reduction of overall length, has been announced by Harlow H. Curtice, president. Public showing of the new cars is scheduled for February 1.

The new body types include a four-door sedan, sport coupe, business coupe, and convertible coupe. Delivered prices at Flint range from \$915 to \$1,138, representing reductions from \$20 to \$31 under corresponding models of the 121-inch Series 40 models. Chassis units are basically identical with those in the Series 40 cars.

R. J. Arnold

R. J. Arnold, treasurer of General Motors of Mexico, died Jan. 19 in Washington of pneumonia. He was stricken in Mexico City and an airplane was chartered to take him to Philadelphia, but bad weather forced the plane down at Washington. Arnold was 46 years old and had been with GM Export Corp. for more than 15 years.

SKF Adopts Pension Plan

SKF Industries, Inc., Philadelphia manufacturers of ball and roller bearings, has inaugurated an annuity-compensation plan through the Equitable Life Assurance Society of U. S., supplementing the Social Security benefits to employees at the retirement age of 65 years.

CENSORED

An exclusive feature prepared by the London correspondent of AUTOMOTIVE INDUSTRIES, M. W. Bourdon.

As a wartime measure to make better use of road transport facilities, the maximum unladen weight of trucks with a legal speed of 30 m.p.h. has been increased from 2½ to 3 long tons. Hitherto trucks over 2½ tons have been confined to 20 m.p.h. A corresponding increase from 3 to 3½ tons applies to trucks using coal gas or producer gas as fuel.

* * *

A serious shortage of renewal parts for trucks has resulted from the greatly restricted production enforced by the Ministry of Supply. It is said that large numbers of vehicles, including many of American makes, that had been operating on transport services of national importance are now idle for lack of some essential replacement part.

* * *

Municipal authorities, who have responded to the Government appeal for scrap metal by tearing up disused tramcar rails, have not gained financially by so doing. On the contrary, reports regarding 1330 tons of rails show that while the cost of recovery and making good the roads was £15,770, only about £8,000 of scrap was secured.

* * *

A big increase in the number of applications for car license renewals for 1941 is reported from areas considered relatively safe from air attack. In one county, Lancashire, it is said that some 250,000 car-owning "strangers" have recently taken up residence and increased to that extent the number of car license applications within the county.

* * *

Miss England III has been destroyed by enemy action. It may be recalled that in 1932 she secured the world's water speed record on Loch Lomond, Scotland, at 119.75 m.p.h. driven by Kaye Don.

* * *

The latest monthly returns of road fatalities, for November show a further increase, the total being 1146 as compared with 926 in November, 1939, despite a great reduction in the number of private cars in use. In some quarters the increase is ascribed to the immense increase of military vehicles on the roads day and night.

Out of 40,000 bus and tramcar drivers and conductors employed in Central London only 24 have been killed and 138 injured in air raids since the outbreak of war.

General Tire Reports Earnings and Expansion

The General Tire & Rubber Company realized a net profit for the fiscal year ending Nov. 30, 1940, of \$595,916.95, after all charges and Federal income taxes, on net sales of \$23,214,314.11. The company's statement shows net current assets of approximately \$9,000,000. Inventories at the end of the year were approximately \$1,500,000 over the levels of a year ago due in large measure to stocks of crude rubber maintained because of conditions in the Far East. The company is reported to have practically completed liquidation of its inventories and receivables in Holland and the Scandinavian countries, without appreciable loss.

The company has a management contract with a Venezuelan company whose plant is under construction. It is expected that production of tires will start in March. Preliminary negotiations have been completed for the formation of a company in Chile to manufacture tires.

William O'Neil, president, also announced that construction has been started on a new building which will increase the factory floor space of the Akron plant by approximately 25 per cent. All plant facilities are now operating at full capacity.

Mr. O'Neil points out that the favorable outlook in the replacement market is especially important to General, which does no passenger car original equipment business, but concentrates on the production of tires for retail sale through dealers. The company is announcing two new tires to meet the increased demands of car owners in every income bracket.

NAM Makes Census For Defense Mobilization

Looking to the most comprehensive mobilization of the nation's resources ever undertaken, the National Association of Manufacturers in a practical commemoration of the Jan. 20-25 "Preparedness Week," has gathered from every plant known to the association information regarding facilities for use in an "all out" defense program. The information has been turned over to the Office of Production Management of the National Defense Advisory Commission.

Giving impetus to the census, William S. Knudsen, director of the Office of Production Management, in a letter to President Walter D. Fuller, NAM president, urged manufacturers to give the greatest possible performances "of American ingenuity, backed by every machine and piece of equipment available."

The NAM survey, made through an exhaustive questionnaire, contemplates the 100 per cent armament for which Mr. Knudsen has asked. It covers every known plant, regardless of size, the

small foundry, "back-alley parts" maker, the one-man machine shop, up to the largest organizations of the country. Should any plant, small, new, obscure, large and well known, have failed to receive an NAM questionnaire, the OPM has asked that the plant notify the NAM. The OPM will make the information available to procurement officers of the government services and to manufacturers in each region, searching for facilities which, by sub-contracting or any other means, can be used to expedite delivery of defense requirements.

40 YEARS AGO

Early automobiles for commercial purposes as well as for pleasure had to face a skeptical public. But no criticism of their usefulness in that respect passed unchallenged, and, in one case, brought forth the following reply:

"The objection raised by some of the Chicago dry goods dealers to steam and gasoline on the ground that they are dirty and noisy is far-fetched. The operator of a steam or gasoline delivery wagon in this line may come in contact with oil and grease in the discharge of his duties, but he does not touch the goods he carries. Boys attend to the house to house delivery, and so far as the odors or exhaust are concerned, if these are not injurious to baker's goods they certainly are not to dry goods or other merchandise of this class. The engineer and fireman of an express train don overalls in the cab while the passengers ride behind in silks and broadcloth."

From the *Horseless Age*, February, 1901.

Four Wheel Drive Co. Announces 1941 Trucks

Introduction of a complete line of newly styled trucks for 1941 has been announced by the Four Wheel Drive Auto Co., Clintonville, Wis. Attractive new styling, major mechanical improvements that increase the performance, lighter weight and greater accessibility are the new features.

The newly designed trucks of the lighter "H" series are now available and the remaining 15 models of the FWD line will be announced soon. All models are furnished in both conventional and cab-over-engine design.

Provision has been made for the use of optional engines, which in the "H" series permits engines from 85 to 113 hp. Two series of axles are available in these trucks to take gross loads up to 20,000 lb. The transfer case is arranged so that a power takeoff can be installed that will utilize all the speeds of the transmission and the full torque of the engine.

The fender arrangement accommodates all types of snow plows and front end equipment without alterations to the skirting and fenders. Another feature allows for either a high or low mounting of the engine, transmission and transfer case.

MEMA Elects Officers

At a recent meeting of the board of directors of the Motor & Equipment Manufacturers Association, the following officers were elected for the current year:-

President, H. R. Kerans, K-D Lamp Co.; vice-president, R. B. Davis, Raybestos-Manhattan, Inc.; secretary, E. A. Hall, Hall Mfg. Co.; treasurer, C. P. Brewster, K-D Mfg. Co.



Worker's Tax Conference

This year many industrial workers will pay an income tax for the first time. Pontiac Motor Division has set up a bureau to assist its hourly employees in filling out their income tax statements.

PUBLICATIONS

The Felters Co., Inc., has just issued a booklet called **"Felts For Sealing and Lubricating Bearings"**, which is designed to tell engineers about the different uses to which Felters' Certified Felts can be put. It is also designed to help engineers select the type of felt or felt combinations which can be applied to their particular use.*

Binks Mfg. Co. has announced a new **spray painting catalog**, containing 92 pages, covering all types of spray painting and finishing equipment. The catalog is loose leaf in form. It gives complete engineering data and specifications, together with prices on spray booths, spray guns, oil and water extractors, air supply and air exhaust systems, portable painting outfits and automatic finishing equipment.*

The Electric Furnace Company has issued reprints of an article, **"Chain Belt Conveyor Furnaces, Their Design, Construction and Application"**, by W. F. Ross, Engineer. The article shows furnace details and contains illustrations of electric and fuel fired chain belt furnaces, including radiant tube and special atmosphere installations for the continuous heat treatment of miscellaneous small and medium sized products.*

A folder issued by the Jessop Steel Company gives information regarding its **non-magnetic steel**, a machinable austenitic steel developed especially for use in electrical equipment.*

The Lincoln Electric Co. has issued Application Sheet No. 72, on **Machine Design**.*

American Concrete & Steel Pipe Co. has published a new catalog for **Amercoat**, a corrosion resisting, plastic coating, which has been developed during the past five years. The catalog, which is illustrated, explains the diversified uses to which Amercoat may be put in modern industry.*

John S. Barnes Corp. has issued two folders, one on its **power and control panel** with speed adjustment for type PA-2041-BA and Type PA-3320-A and the second on its **index power and control panel**, Type PA-28.*

Ampco Metal, Inc., has issued Engineering Data Sheets Nos. 47 and 48. The bulletin is illustrated with diagrams, showing the correct methods for **drilling, reaming, tapping, milling, and grinding Ampco Metal**.*

American Foundry Equipment Co., Mishawaka, Ind., has just published an attractively colored, 72-page testimonial book entitled, **"What Users Say About Wheelabrator Performance"**.*

Caterpillar Tractor Co. has a new folder on **"Caterpillar" Diesel Power**.*

The Brown Instrument Co. has just published catalog No. 1104 on **Brown Potentiometer Pyrometers**. The catalog contains illustrations of the interior and exterior views of indicating, recording and control pyrometers. Also described and illustrated are the Brown Radiamatic Pyrometer, auxiliary switches, control accessories, multiple key switches, thermocouple installations and a list of chart and scale ranges and drilling and mounting dimensions.*

The South Bend Lathe Works has just issued a new general catalog. The catalog is illustrated and contains 50 different sizes and types of **South Bend Back-Geared, Screw Cutting Lathes** for manufacturing, tool room and general shop work.*

An attractive booklet, entitled **"The Army Rolls"**, has just been published by The Timken-Detroit Axle Company. The booklet describes and illustrates Timken products for the motorized U. S. Army.*

General Electric Co. has issued the following bulletins: GEA-2234C, **Manual Motor-Starting Switch** CR1061; GEA-3469, **New Push-Button Stations**; GEA-2599, **Why FH Cubicles?**; GEA-3488, **How to Maintain D-C Motors**; GEA-3523, **new G-E Gas-Carburizing Electric Furnace**.*

The January issue of **Bakelite Review** has been released by the Bakelite Corp. The booklet contains an article entitled **"Consideration of Plastics in Airplane Design"**, together with information for manufacturers, designers, engineers and chemists on

the latest developments in Bakelite materials and their application.*

Power Alcohol—History and Analysis, published by the Committee on Motor Fuels of the American Petroleum Institute, and containing information on performance characteristics and relative fuel values of alcohol blends, the problems of producing and distributing alcoholized fuels, the need or lack of need of such measures as an aid in conserving petroleum supplies, use of blends abroad, and related subjects. The incentive which led to the publication of the pamphlet was the publicity which has been given in recent years to the idea of compelling use of alcohol as motor fuel to provide a market for farm products.

* Obtainable through editorial department, AUTOMOTIVE INDUSTRIES, Address Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

30-Day Strike Notice

(Continued from Page 131)

Van Wagoner dispatched 150 state police to the scene to maintain order.

Sympathy strikes closed Eaton plants at Detroit, Marshall and Battle Creek in Michigan, and also Cleveland, but these were reopened and arrangements made to return the UAW-CIO strikers at Saginaw to their jobs when Dewey brought the unions and management together. After the NLRB ruling, Irvan Carey, president of the UAW-AFL, said the 250 UAW-CIO strikers would have to apply to the shop committee for reinstatement and would be required to join the UAW-AFL after 200 hours' employment, with loss of seniority.

Nine thousand UAW-CIO members in the Chevrolet Division of GM at Flint authorized a strike by a 10-1 count in a dispute over collective bargaining procedure. Dr. George W. Taylor, new umpire under the GM contract, entered the dispute Jan. 22 and was expected to render a decision which will be final under the contract provisions. Layoff of a union committee-man precipitated the strike vote.

A blanket wage increase in General Motors plants covering 160,000 workers due to higher living costs will be recommended to the GM Council of the UAW-CIO when it meets in Detroit Feb. 10. The union also is dissatisfied with a GM proposal to give 80 hours' pay to hourly rated workers who are drafted, terming the amount inadequate. Negotiations for a new contract are due to open in February. The present contract expires June 24.

The Electromotive Division at La Grange, Ill., became the sixty-ninth GM plant to vote for the UAW-CIO as sole bargaining agent as the result of a 1520 to 580 vote in a recent NLRB election.

An unauthorized five-day strike at the parts plant of the Chrysler Corp. in New Castle, Ind., ended Jan. 20 when Roy J. Thomas, president of the UAW-CIO, threatened to rescind the local's charter for violation of the contract. The 2500 workers, who had walked out in a dispute over payment demands for a 15-minute lunch period, voted to return to work by 1,600 to 900

rather than form an independent union. Meanwhile, the NLRB ordered an election in the Chrysler assembly plant at Evansville, Ind.

A special three-man board, composed of Thomas J. Donahue, Detroit attorney; D. D. Harris, Lansing automobile dealer, and Walter Moers, member of the State Labor Mediation Board, was appointed by Gov. Van Wagoner to arbitrate a dispute at the Motor Wheel Corp. in Lansing. The UAW-AFL had voted to strike when the company refused to grant a union shop clause in negotiations for a new contract.

The Ford Motor Co. through I. A. Capizzi, its attorney, refused Jan. 17 to consent to an NLRB election in its Lincoln plant. The UAW-CIO had sought the election among 3800 Lincoln plant workers to determine a collective bargaining agent. The NLRB will now hold a hearing to determine if the UAW-CIO has sufficient membership to warrant holding an election.

A proposed order of the NLRB issued Jan. 18 ordered the Ford Motor Co. to reinstate with back pay 1021 workers in its Kansas City plant who allegedly were replaced during the shutdown in the fall of 1937. The NLRB order also directed Ford to cease discouraging membership in the UAW-AFL and to disestablish the Independent Union of Ford Workers which, it charged, was a company union. The company has 50 days in which to file briefs and request oral arguments on the order, which was the seventh issued against Ford.

ADVERTISING

Matthew J. Casey has been named vice-president and manager of the Detroit office for Ruthrauff & Ryan, Inc. At one time assistant general manager of the Pierce-Arrow plant for the Studebaker Corp. and later one of the founders of the Differential Wheel Corp. Casey recently was engaged in promotional work for the Hearst Magazine Corp.

Herbert D. Bissell, for the last 11 years a representative of N. W. Ayer & Son, Inc., in Detroit and Philadelphia, has been named advertising manager of Electric Auto Lite Co., Toledo. George Lasko, formerly with Graphic Arts in Toledo, has joined Auto Lite as head of the new art and designing department.

James P. Wines, formerly in the Detroit office of Arthur Kudner, Inc., has been transferred to the agency's New York office as account executive on the Fisher Body account, succeeding the late Frank Chance.

A total of 951,558 persons visited the Rotunda building of the Ford Motor Co. at Dearborn in 1940, surpassing the previous year's record by 240,000 persons. Visitors, who toured the Rouge plant, numbered 166,519. There were 876 visitors from foreign countries, most of them from South America.

Frank J. Mullen, associated with the late Theodore F. MacManus as advertising counsel for Willys-Overland Motors, Inc., on promotion of the new American, has resigned as account executive for U. S. Advertising Corp.

Carter, Jones & Taylor advertising agency has moved to enlarged quarters on the fifth floor of the Associates Building in South Bend, Ind.

The Essentiality of the Automobile Accentuated by Defense Demands

(Continued from page 103)

A vital element in the life of our country, the importance of the automobile has been accentuated by the national defense program which requires mobility of workers and is reflected in the jammed parking lots at industrial plants. At airplane factories in Paterson, N. J., and San Diego, Calif., at shipyards in Quincy, Mass., and Portsmouth, N. H., and at hundreds of other industrial centers, workers are commuting to the factories by private automobile, sometimes from a distance of 50 miles, thus averting housing shortages and a dislocation of populations.

Figures compiled by the U. S. Public Roads Administration from 25 states show that more than one-half of the driving done in personal automobiles is for purposes which can be classified as business objectives. On a mileage basis, 55 per cent of the total is for business. This breaks down to 51 per cent for urban residents and 64 per cent for rural dwellers. In fact, 48,492 communities in the United States are served only by motor vehicle transport.

A traffic survey in Boston showed that while approximately 800,000 persons entered the central zone by mass transportation means, an additional 500,000 used their own cars for the same daily movement. In Los Angeles 56 per cent of those entering the central business district used private automobiles, while in St. Louis it was 50 per cent and in Detroit 49 per cent. In cities of 100,000 to 500,000 population 70 per cent use their own cars for such transportation.

Recently Paul G. Hoffman, president of Studebaker Corp., said, "Public surveys show that the annual road travel (by automobiles) of 287 billion vehicle miles . . . is preponderantly for necessity purposes. There is growing a realization that this flexible and efficient transport system, profoundly identified with new social and economic conditions, has a meaning for national defense that goes far beyond the concept of mobility."

For the 10 years from 1930 through 1939, it is estimated that 85 per cent of new vehicle sales were to replace old vehicles that had been scrapped. Thus an average of 2,388,000 motor cars were scrapped annually. To maintain present rolling stock at its current level, it is estimated that more than 3,000,000 vehicles had to be manufactured in 1940.

Automobile manufacturers are going forward with plans for 1942 models which, of course, are dependent upon conditions in the industry next fall. Most changes of necessity will be minor ones due to limited retooling facilities, but some changes may be urgent in order to substitute for materials in

which there is a likely shortage due to national defense demands.

Passenger cars may still be used for pleasure, but they also are an integral and essential part of the daily life of the 131,669,275 persons in the United States.

Col. William Guy Wall

William Guy Wall, one of the pioneers of the automobile industry and a past president of the SAE, died of heart disease at his home in Indianapolis on Jan. 16. He was born at Baltimore, Aug. 17, 1875, and, therefore, was 65 at the time of his death.

He studied civil engineering at Virginia Military Institute and later took a course in electrical and mechanical engineering at M.I.T., from which he was graduated in 1896. Toward the end of the century he built a gasoline automobile in Richmond, Va., and when the National Motor Vehicle Co. was formed in Indianapolis in 1900, he joined that organization as mechanical engineer. He later became chief engineer of this firm and was responsible for the design of its successive passenger-car models, as well as for the racing car which won the Indianapolis race in 1912. In May, 1917, Mr. Wall entered the Army as a major in the Engineering Division of the Ordnance Department, and during the following year he became a Lieutenant-Colonel. When the National Motor Vehicle Co. went out of business, he established himself as consulting engineer. In 1928 he served as president of the SAE. Last August, after two years' retirement, he was called back into the Federal service.

Statistical Method of Quality Contact

(Continued from page 128)

testings—fuses, lamps, condensers, electroplated coatings, flaws and inclusions in ferrous and non-ferrous materials and die castings.

4. For the sampling inspection of any product except items requiring 100 per cent inspection.

Basically, the statistical method applied to quality control can be put to practical use by the adoption of a few simple ground rules available in current literature (refer to bibliography) which can be acquired by any engineer selected to cooperate with the production department. Any organization boasting an industrial statistician on its staff (and there are many in the automotive industry) can investigate the matter even more deeply. And in the final analysis, if the method is given a fair trial and then shows possibilities, an extension of applications based upon a more intimate knowledge of statistics can be developed with the air of a specialist in this field.

One of the most active personalities in the field of applied statistical method, Dr. W. A. Shewhart of the Bell Telephone Laboratories, has written a standard reference book (3) on the subject, recommends the use of "control charts" based upon what he terms Criterion I, which is described in his book.

Since the subject is treated fully in the references listed in the bibliography, we shall not take the time or space in this brief discussion to describe the simple tools that are available. Suffice it to say at the moment that Shewhart's Criterion I is resolved into a control chart technique. The control chart consists of points representing each inspection plotted on a chart containing a central line and

upper and lower boundaries. The central line indicates the general average quality as it exists in the product. The upper and lower lines indicate the limits within which inspection points must and will lie as long as a homogeneous product of this quality level is maintained. The presence of a point outside these limits indicates that quality has altered with respect to quality level or uniformity. It does not indicate the assignable causes of the change in quality. However, it shows *when* the trouble occurred and the nature of its effect, which is in general all the engineer needs to successfully discover and eliminate the cause of change. Each source of trouble which is unmasked and eliminated results in an improvement in quality and reduction in costs. The entire procedure is very simple and can be applied to various measures of quality such as averages, fraction defective, percentage of reject, and range or spread between the extreme values of plus and minus variations. These are all covered in the literature. (See Bibliography at end of this article.)

Now the practical man will say that there is nothing new in this concept of sampling inspection. That is true only in so far as we know that sampling has always been employed in one form or another for many years. In the old method of inspection, limits are established by administrative procedure; when a sample exceeds the limits it is considered bad and the material must be rejected. In the statistical method of inspection, the fact that a sample lies outside the limits indicates that something has changed in the production process and that an engineering survey is in order. The economic advantages result from the discovery and elimina-

tion of sources of changes by the engineers.

Thousands of practical examples over a period of many years, indicate that when this technique is used and a sample lies outside the action limits, a source of trouble can be found in over 99 per cent of the cases!

To us the vital thing about the adoption of the statistical method is concerned not so much with the rules as with the philosophy or slant acquired by those who use it. The first step comes in the understanding that quality control is possible only under controllable conditions. Thus the application of the new method prompts the production department to re-check every step in a given process to make sure that the machinery is in good operating condition, that the tool setting is precise, that the raw materials conform to specifications.

In the beginning of the project, the control chart is based upon past performance—assuming that such a record exists—then progresses to the conditions built up as the system begins to act in current production. Once standard conditions have been established, the chart will indicate any tendency to veer from controlled conditions, serves to warn of such tendency during the course of production.

In the case of raw materials, the method teaches the need for separating the production of different suppliers, makes it imperative to chart each supplier separately. When this is done, the cumulative record will show un-failingly the performance record of each supplier, thus separating the good from the bad, pointing to the consistently reliable sources. As a matter of fact, in the final analysis the product of the consistently reliable source may be accepted safely with less and less inspection.

How does this apply to the relations between you and the user of your product? Acceptance specifications frequently imply judgment factors. You turn out what is an acceptable product, thoroughly inspected by your own men. But at the other end a certain percentage of the product is rejected. Now if you could prove to the customer that your product is under control in every respect, by exchanging control charts as evidence, or if the customer has built up a record of your performance over a period of time—if your record is good, the customer will have confidence in your product.

This mutual understanding will go far to reduce the amount of inspection and cost of inspection by the customer and will eliminate the rejection of many items which really are acceptable. That in fact is the reason why the War Department has requested the ASA to initiate the standardization project. If a workable formula is developed, and if it is used, the relations between suppliers and users will expedite the work of national defense. If it is good for an emergency, it may be a valuable tool for normal operation.

Consider some specific examples. Sup-

pose you are checking the Brinell hardness of cylinder blocks as they come from the foundry. The control chart record based upon 100 per cent inspection over a long period of time may show such good control as to make it possible to institute a sampling inspection. That would release the blocks faster, would cut the cost of inspection, provided the record warranted such confidence in the foundry. At the same time the proper kind of sampling procedure would serve as a check on the process so that any deviation from normal could be spotted immediately.

Suppose you are interested in a surface quality specification of, say, 4 to 6 microinch limits on crank pins and journals. At first it would be imperative to inspect every crank with a Profilometer and keep a running record with which the finishing process could be checked and re-checked and corrected. Eventually, the method of finishing would be under control. When confidence has been established, it should be possible to reduce the amount of inspection, and finally get it down to a basis of small samples at hourly or daily intervals. The control chart then would become the watch dog of quality.

As we mentioned earlier, a sampling procedure may not be applicable to processes or assemblies which require 100 per cent inspection. In fact, at the outset it might be safer to restrict the application of statistical method to those things which have relatively wide limits on acceptance. Over a period of time, experience with the method and confidence in its use will indicate other applications, and eventually will lead to a sampling control of even those processes in which 100 per cent inspection has been a traditional procedure.

To sum up this situation, we know

that progressive management is interested in anything that promises better control at less cost. That is why we propose a fair trial for the statistical method. Fortunately, it is not an expensive procedure and can be initiated by any organization willing to try it out.

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MEN and MACHINES

(Continued from page 127)

and foot-mounted, ball-bearing types and are readily accessible. There are only two gear contacts in the spindle drive from the motor to the cutter.

IN ANNOUNCING its new line of fluorescent lamp ballasts, Acme Electric & Mfg. Co. of Cuba, N. Y., asserts that these units have performance characteristics that meet the requirements of the fluorescent type lamps they are designed to power. The fluorescent type of lamp requires exact voltage control to perform satisfactorily. The manufacturers of the Acme line claim to have achieved this important requirement, thus providing the secondary results of quick starting and humless operation. These ballasts are available in 15, 20, 30, 40, 65 and 100 watt sizes for both single and double lamps.

AIRCRAFT-ENGINE gears are now being lapped on a new-type, highly-flexible two-lap lapping machine developed by Michigan Tool Company, Detroit. This machine, shown in the group on page 127, is automatic in operation, and although designed to accommodate a wide variety of sizes and types of gears, it has high production capacity on moderate- and small-sized gears.

The machine operates on the well-known Michigan crossed-axis principle; its operating features include a relatively low surface speed of rotation and high speed of reciprocation of the laps across the faces. The latter may be adjusted from 90 to 300 reciprocations a minute. Change gears permit ready adjustment of the lap-spindle speed from 52 to 283 r.p.m. A third

adjustment varies the reciprocating stroke length.

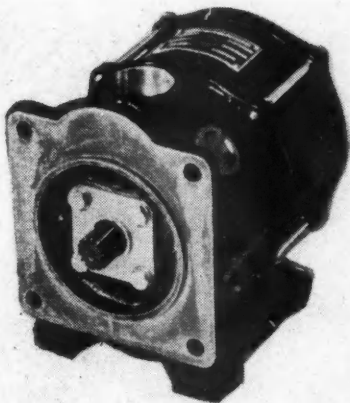
At the end of the lapping cycle, one head and lap retracts, permitting ready unloading and reloading of the machine. The arrangement is such that when the retracted head returns, its lap is in mesh with the gear to be lapped.

NEW SMALLER a.c. squirrel-cage ball-bearing induction motors especially designed for general purpose industrial, machinery drive applications are announced by the Westinghouse Electric & Manufacturing Company. These new CS motors are available in ratings from $\frac{1}{2}$ to 5 hp., with speeds from 875 to 3600 r.p.m., for operation on 110, 220, 440, and 550 volts, two- and three-phase alternating current.

Among the improvements incorporated in these new motors are a "permanently sealed" ball-bearing which requires lubrication only once every three years, and specially-developed plastic wire coating which is claimed to give maximum dielectric strength, toughness, and flexibility. Reinforced cuffs at slot edges protect windings from abrasion, and coil ends are taped to brace them against the strains of full voltage starting.

AIRCRAFT direct-current electric motors that combine lightness and compactness with high power output and range from 1/100 to 3 hp. are now being manufactured by Air Associates, Inc., Bendix, N. J. Motors are built according to U. S. Army Air Corps Specifications, with standard-size mounting pads, shaft fittings, and terminal connections, or with special fittings for commercial applications.

This line of motors is designed expressly for aircraft power needs such as the operation of hydraulic and fuel pumps, landing gear retracting mechanisms, tow target winches, anti-icing



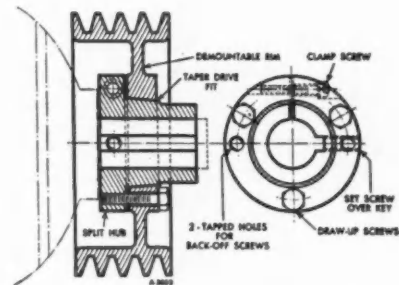
Electric motor for use on aircraft
made by Air Associates

equipment, wing flaps, and a variety of other uses.

Magnesium alloy castings are used for the motor frame, to reduce weight;

motors are insulated with fiber glass and special heat-resisting varnish. All models are radio shielded, and shafts turn on precision ball bearings. Motors are available in 6; 12- and 24-volt models, for continuous or intermittent service. They may be series or shunt-wound and provided with a forced draft, or with an internal fan.

A NEW type of V-belt driver sheave has been announced by Worthington Pump and Machinery Corp., Harrison, N. J. It is suitable for applications where quick mounting and dismounting of the sheave are desirable.



Worthington quick-detachable,
quick-dismountable driver
sheave

TAPPING SHELL FORGINGS

A TOUGH JOB made
easier
with **Stuart's**
Thred-Kut

use **Stuart's**
SOLVOL
LIQUID CUTTING COMPOUND
for turning!

This new emulsifying cutting oil was developed especially for high speed turning jobs that require inspection-passing finish. It has higher cutting quality and rust preventative value than ordinary soluble cutting oils. Solvol Liquid Cutting Compound handles certain tapping and threading jobs that before needed a straight oil. Try it—you'll be pleased.

THERE is one sure way to simplify this and other tough jobs: Use **STUART'S THRED-KUT**, the cutting oil that solves the difficult cutting problems. Wide use by government armories, arsenals and by the aircraft industries recommends it! Put **THRED-KUT** to work for you Now! You'll save time, money and headaches.

Write . . . wire . . . phone for a trial drum. There is a Stuart engineer to help you on lubrication problems, without obligation.

SEND FOR the new Stuart 48 page handbook on Sulphurized cutting oils—it contains valuable information for anyone that has metal cutting problems. Please request on company letterhead.

For All Cutting Fluid Problems

D. A. STUART OIL CO.

Chicago, U.S.A.

LIMITED

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Warehouses in All Principal Metal Working Centers





Jackson Products improved eye shade

Each sheave unit consists of two parts, a longitudinally-split clamp hub and a V-grooved rim. The hub is clamped to the shaft by means of a cap screw in its flange and is securely fastened by a standard keyway. A fit equal to a press fit, on shafts up to ten thousandths over-size or under-size, is provided. The rim is taper-fitted to the hub and is fastened with draw bolts.

To remove the rim, the draw bolts are withdrawn and two of them are inserted in holes so tapped in the rim that the bolts act as jamb screws and bear against the hub, thus forcing the rim off the taper without disturbing the position of the hub. It is claimed

that with this equipment dangers of battered motor bearings, bent shafts, broken sheaves, and human injury are eliminated.

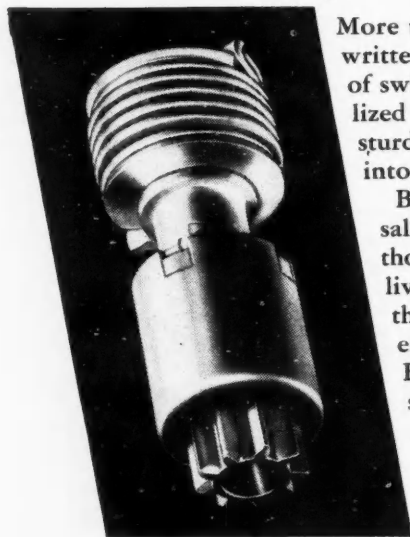
THE JONES & LAMSON MACHINE CO., Springfield, Vt., has added a new vertical model to its line of optical comparators. This is an all-metal machine of rugged construction and is said to be suitable for both laboratory and shop use.

Set in the 8 by 7-in. object-staging table, coaxial with the condensing and projection lenses, is a 3¼-in. glass disk on which objects may be staged for projection. To focus the object, the table is adjusted vertically by a screw at the top of the machine. An 8-in. round, ground and lapped mirror, coated with aluminum oxide, reflects the shadow of the object onto a 14-in. receiving screen in convenient sight of the operator.



FOREVER

starting something!

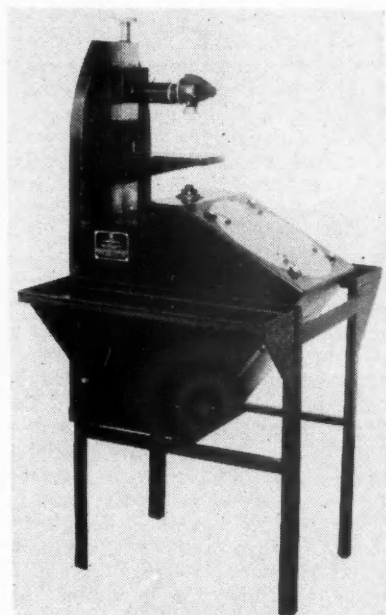


More than fifty million engines have written an indelible record of *billions* of swift, sure, easy starts in every civilized land . . . because of this small and sturdy Bendix mechanism engineered into the starting system.

Bendix Drive has been an asset—for sales and for service-satisfaction—on those fifty million engines. It has delivered performance and reliability that have been a constant credit to the engineering judgment that specified Bendix Drive. It will continue to do so in the thousands of new cars and trucks that go into service daily.

ECLIPSE MACHINE DIVISION
OF BENDIX AVIATION CORPORATION
ELMIRA, NEW YORK

BENDIX DRIVE



Jones & Lamson new vertical comparator

This machine is designed for checking small, flat objects which can be laid directly on the glass stage. The enlarged shadow of the contour can be compared with an outline on the screen. A table for making coordinate measurements is available for the machine, as are projection lenses ranging in magnifications from 6 to 100, in distance between lens and object from 37/16 in. to 1 in. and in maximum diameter which the lens will project from 1.500 to 0.140 in.

A UNIVERSAL slotting head that can be used for precision work on milling machines of all types has been announced by the Experimental Tool and Die Co. of Detroit. The stroke of the ram is adjustable from 0 to 4 in. A ¼-hp. motor with four speed changes gives speeds ranging from 50 to 250 or from 100 to 580 strokes per minute.



Universal slotting head
Milling-machine bracket

The tool holder, which is of the clapper-box type, can be turned to any position desired.

This precision slotting head can be used for cutting keyways, templets, splines and internal gears, and for slotting out precision blanking dies. It measures 18 in. in length, 8 in. in width and 12 in. in depth, and comes complete with pulleys, motor, belt and the mounting adapter for whatever type of milling machine it is to be used on.

A NEW type of wire stripper, one that burns the insulation, is announced by Ideal Commutator Dresser Co., Sycamore, Ill. It is specially suited for stripping cotton, silk and rubber coverings from fine stranded or solid wires. With this stripper it is said to be impossible to cut strands or to nick, scrape or injure the wire in any way, for the blunt blade cannot injure the finest wire.

In operation, wires are inserted between the electrically-heated blades in the stripper head. Pressing the pedal brings the blades against the insulation, with the result that two parallel grooves are burned right down to the conductor. The grooves are completed with a slight twist to the right or left, and a pull then removes the insulation, leaving a clean edge.

AN IMPROVED eyeshield for use in gas-welding, cutting and blow-torch operations is announced by Jackson Products, Detroit. This Type BX is a cover-all shield, the use of which does not interfere with the wearing of prescription glasses. Enlarged opaque fiber side pieces afford greater protection. The light, opaque frame fits snugly to forehead and cheeks, barring light and sparks.

The shield takes a standard 2 by 4½-in. lens, secured in the lens-retaining frame by an improved spring. The connection between shield and head-gear provides better adjustment of lens

angle with reference to the face. Advantages claimed for this new eyeshield are a wide range of vision and the ease with which the entire lens assembly can be pushed up out of the way when not needed. Its lightness and non-fogging features are said to encourage workmen to use this shield. See illustration on facing page.

THE Chisholm-Moore Hoist Corp., Tonowanda, N. Y., has added a one-ton size to its line of portable, plug-in type of Comet electric hoists. The new model is available with hook suspension for easy portability, or with a trol-

ley attached for overhead conveyance. Heavy-duty, high-torque motors are supplied for either 110-volt lighting circuits or 220 or 440 power circuits.

MULTI-MOTOR MOUNTINGS, which provides for individual motor installation on all types of used machine tools, is announced by Western Manufacturing Company, Detroit. It accommodates NEMA frames Nos. 204 to 326 (1-15 hp. at 1800 r.p.m.), including practically all Canadian, British, South American and overseas motors, together with older and special motors up to 10 hp. used in the United

"Cracker Barrel Steel" is Gone!



BACK IN THE "GOOD OLD DAYS" crackers came in barrels; and many people bought steel, too, with no clear idea of what it was, or how it was made. Methods of storing and handling were "hit and miss"; results to be expected were uncertain! Crackers were crackers; steel was steel!

It is different today—with both! The Ryerson plan of Certification provides definite data on every ton of the steel in the vast Ryerson stocks. You *know* the steel you're getting. You have accurate information as to its chemical and physical characteristics, its strength, hardness,

heat-treatment response! You can select Ryerson Certified Steel with positive assurance that it is the kind and quality exactly suited to the job you want it to do.

Ryerson stocks are complete; shipment is immediate! One of the ten Ryerson plants, conveniently located near you, is ready to serve you. Get acquainted now with the many advantages of this modern steel-service. 1940-41 Stock List will be sent promptly on request.

JOSEPH T. RYERSON & SON, INC., Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City.

RYERSON *Certified* **STEELS**



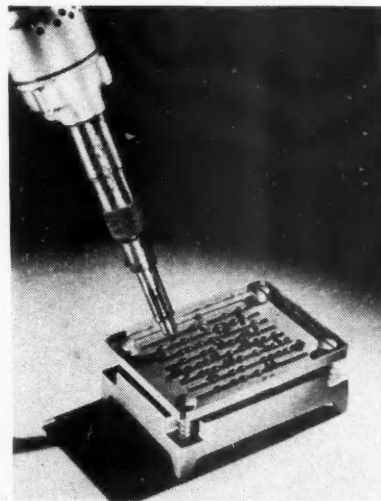


**Multi-motor mounting
of Western Mfg. Co.**

States. There are three models of multi-motor mountings, viz., a lathe mounting bracket, a standard shaper bracket, and a milling-machine bracket. The latter, which comes in two sizes, 7-in. and 9-in., is illustrated herewith.

A NEW method of handling screws on assembly operations, recently announced by the Independent Pneumatic Tool Co. of Chicago, is claimed to increase the speed of power-driving of screws by from three to nine times. A new device, known as the Thor "Pix-Up" finder and Adjusto Tray, sorts, picks up, and holds screws for driving. It eliminates the time-wasting hand operations of picking up screws by the fingers and starting or holding the screw in the tapped or drilled hole.

The unit consists of the Adjusto-Tray, a novel arrangement of a screw-holding tray, which is spring mounted



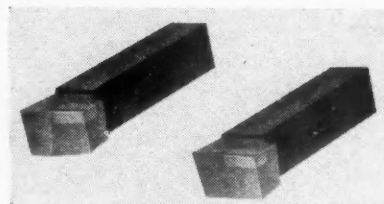
**Independent Pneumatic Tool Co.
has a new method of handling
screws on assembly work**

on a base and adjustable by clamp screws at each of four corners for the particular length of screw to be driven. Into this tray a quantity of screws are spilled; shaking the tray a few times suspends the screws in the slots by their heads.

A power screw driver equipped with the "Pix-Up" Finder is then placed over a screw head, pressed and, as the tray depresses slightly, the finder grips the screw head firmly in perfect alignment, holding it ready for the driving operation.

MCKENNA METALS CO., Latrobe, Pa., has two new styles of tools for facing operations in turret lathes. These new Kennametal tools, Nos. 21 and 22, have 6-deg. side- and front-clearance angles, 8-deg. end-cutting-edge angles, 6-deg. side rake, and 2-deg. negative back rake. Style No. 21 (shown at the top in the illustration) has a 20-deg. side-cutting-edge angle, which results in increased tool life, and this tool should be used where a 90-deg. shoulder is not required on the work. For facing to a 90-deg. shoulder, Style 22 tool, which has a zero-side-cutting edge angle, should be used.

The negative back rake on these tools is made possible by the non-galling action of the Kennametal tip. It has the effect of imparting greater strength to the carbide tip. These tools also have chip breakers, as shown in the illustration.



**Kennametal tools Styles Nos. 21
and 22**

"... all standard steel
chains are immersed in

dag
COLLOIDAL
GRAPHITE

After immersing in colloidal graphite diffused in a quick drying solvent - a clean, tough lubricating film of graphite remains. A prominent manufacturer of chains finds this method of lubricating their product of particular advantage - on conveyors where oil dripping is harmful and on drives that operate in the presence of temperatures that burn off ordinary lubricants.

That company treats all of their standard steel roller chains with "dag" colloidal graphite for they have found that "a graphoid surface on all bearing parts greatly reduces wear, even under ideal conditions where chains operate at high speeds in an oil bath."

There are hundreds of special and ordinary industrial applications of "dag" colloidal graphite dispersed in various liquids for both initial and continuous use - ask your oil supplier about his lubricants containing "dag" brand colloidal graphite. A request to us on your letterhead for Bulletin 130 will bring a working sample.

ACHESON COLLOIDS CORPORATION
PORT HURON, MICHIGAN

dag
COLLOIDAL
PRODUCTS

Motor Boat Show

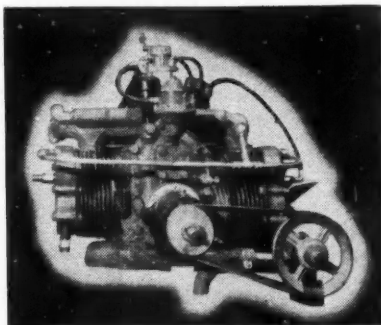
(Continued from page 117)

Bosch injection equipment. A new four-cylinder gasoline engine is rated 30 to 40, 61, and 68 hp. at 2700, 3600, and 3800 r.p.m., respectively. It has $3\frac{1}{2}$ by $4\frac{1}{4}$ -in. cylinders.

The new Mack Mariners are six-cylinder Lanova-type Diesels, with $4\frac{1}{2}$ by 6-in. cylinders; they are rated 100 hp. at 1500 r.p.m., but have a maximum output of 125 hp. at 1800 r.p.m. for intermittent service. Like the other Mariners in the Mack Manufacturing Corporation's line, they are basically Mack truck engines, with more than 80 per cent of the parts interchangeable. With 70 factory-owned branches in the United States and Canada, nearly 50 of which are on tide water or on inland waters, the company can offer unusual service facilities.

Red Wing Motor Co. has brought out a new six-cylinder Hesselman engine rated 100 to 125 hp. at 1500 to 2000 r.p.m. The changeover from gasoline to standard Diesel fuel, ordinary furnace oil, distillate, or kerosene requires about 20 minutes.

The new engine of Palmer Bros. Engines, Inc., is a six-cylinder Diesel, developed from its four-cylinder series. With its 480 cu. in. displacement ($4\frac{1}{2}$ by 6 in.) it develops 60 hp. at 1200 r.p.m. Its compression ratio is about 15 to 1. A feature of the design is a modification of the British patented Russell Newberry cylinder head, said to produce extremely high turbulence, resulting in more nearly perfect combustion at all speeds and loads. Valves are positioned horizontally. Aluminum alloy pistons are used, and these are



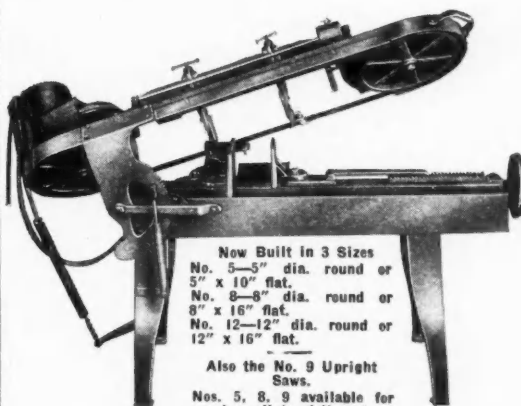
The Crosley marine engine is rated from 8 to 9 hp. at 3000 r.p.m.

fitted with three compression and two oil rings. Individual Bosch injectors supply the fuel. These are of the pintle or self-cleaning type. The engine is fresh-water cooled. The new six weighs 3200 lb.

Among the refinements of the three basic models offered by Chrysler Corp. are additional options in reduction gear sets, providing an even wider range of application for pleasure and work boats. Valve inserts are of tool steel; a combination flame arrester and air-intake silencer adds to the safety features of the engines, and "superfinish" is used on most of the moving parts.

FROM THE Bluebook of Industry REPEAT ORDERS for WELLS SAWS

RESULTS — accurate, dependable, day-in and day-out sawing — that's what brings repeat orders for Wells Metal Cutting Band Saws. Wells Saws feature simplicity, ease of operation, long-wearing parts. For continuous production or the 1001 miscellaneous metal cutting jobs around any plant, you'll be money ahead to buy Wells Saws now!



New Built in 3 Sizes
No. 5—5" dia. round or
5" x 10" flat.
No. 8—8" dia. round or
8" x 16" flat.
No. 12—12" dia. round or
12" x 16" flat.

Also the No. 9 Upright
Saws.
Nos. 5, 8, 9 available for
immediate delivery!

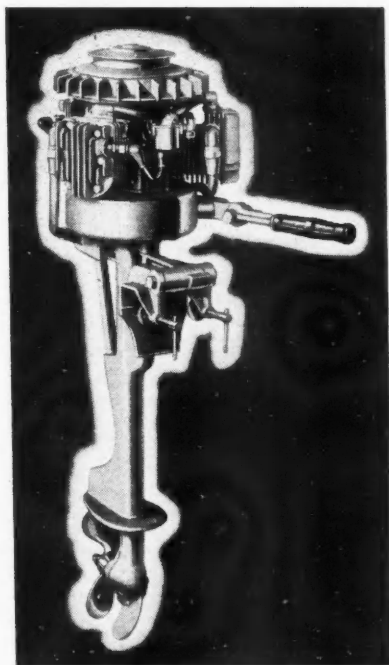
WELLS MFG. CORP.
Three Rivers • Michigan

WELLS METAL CUTTING BAND SAWS

Every one of these firms has tried WELLS Metal Cutting Band Saws and come back for more!

Aluminum Company of America
American Steel Foundries
Baldwin Locomotive Works
Bethlehem Steel Corporation
Buick Motor Division,
Gen'l Motors
Chase Brass & Copper Co.
E. I. Du Pont de Nemours &
Co.
Erie Railroad Company
Loose Wiles Biscuit Co.
Magnus Metal Div. of Nat'l
Lead Co.
Peoples Gas Light & Coke Co.,
Chicago
Proctor and Gamble
R. C. A. Mfg. Co., Inc.
Sherwin-Williams Co.
Superior Iron Works
Union Pacific Coal Co.
United States Rubber Co.
Waltham Watch Co.
Western Electric Co.

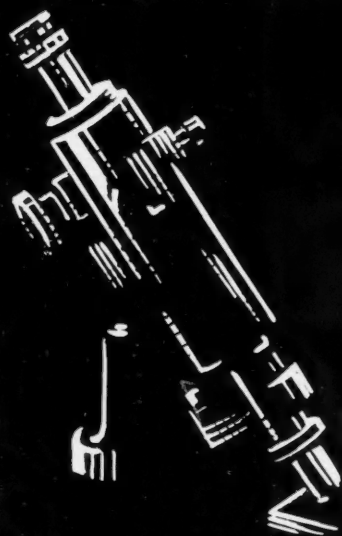
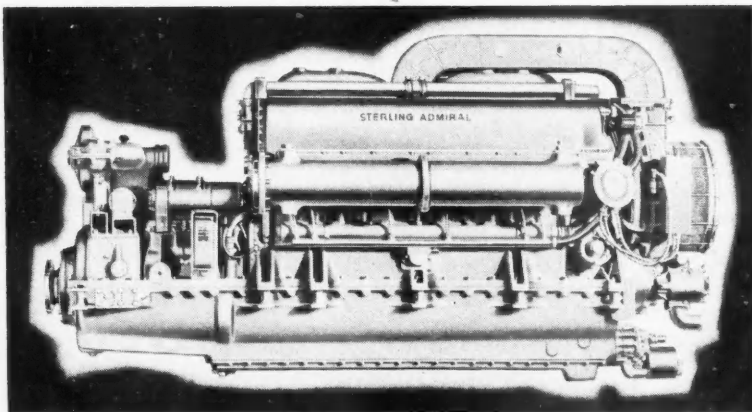
... and dozens of others!



Lauson three-cylinder radial 6-hp. outboard engine with housing removed.

Sterling Admiral 12-cylinder Vee engine rated 1200 hp. when super-charged and 800 hp. without super-charger.

Waukesha Motor Co. has introduced a new Hesselman six, rated 152 hp. at 1800 r.p.m. with its 5¼ by 6-in. cylinders. The engine weighs a little less than 3000 lb. The positive firing feature of this type of spark-compression engine is said to be finding favor among pleasure-cruiser and tow-boat and fishing-boat owners. A newly developed



LABORATORY CONTROLLED

Every Wyman-Gordon forging is under laboratory control from raw material to finished product. They are always guaranteed forgings.



WYMAN • GORDON
WORCESTER, MASSACHUSETTS
HARVEY, ILLINOIS - DETROIT, MICHIGAN

electric transmission, a magnetic compressing clutch and full reverse, is being shown for the first time.

Wisconsin Motor Corp. has added a 22 hp. Vee four-cylinder engine to its line, closing a gap in its 1.8 to 31 hp. line of marine engines. It is a conventionally designed gasoline unit.

Hill Diesel Engine Co., Lansing, Mich., has returned to the marine field with prime movers and generating sets. The 5 x 7-in. engine is produced in three, four, and six-cylinder models, rated 35, 47, and 70 hp., respectively, for continuous output, with maxima of 42, 56, and 84 hp. at 900 r.p.m. The new engines have cylinder heads of nickel-alloy iron, and dry-type, hardened cylinder liners. Exhaust-valve seats, nozzles, and valves are readily accessible. The overhead valves are operated through rocker arms by silent, oil-cushioned tappets and push rods. Aluminum alloy pistons are fitted with six rings, five above the piston pin and one below. Fuel injectors are individual, supplied by Bosch. Air starting equipment for these engines is optional.

Three new air-cooled outboard gasoline engines were introduced by the Lauson Company of New Holstein, Wis. Most interesting among these is a three-cylinder radial engine of 2-in. bore by 1½-in. stroke. The cylinders are cooled by a flywheel fan on top, as shown by the illustration on page 145. Cylinder heads are of aluminum. The crankshaft is a drop forging, counter-balanced and supported in ball bearings at both ends. One master rod and two link rods are used, hence aircraft-engine practice is followed in the crank train. Cylinders are of gray iron. There are three rings on each piston, two compression rings and one oil ring. Oil is delivered to the bearings under pressure. A carburetor of the company's own make is used, while ignition is by a Wico magneto. The estimated weight of this 6-hp. engine is 60 lb.

Johnson Motor Co. offered outboard enthusiasts seven new water-cooled engines, and the company's line of outboard now ranges from 1½ to 22 hp. Full pivot steering has been designed into all the engines, as well as a full

reverse. A wide sweepback of the propeller blades is said to add to the effectiveness of the engine in grassy and weedy waters.

Evinrude motors introduced two full-reversing outboard engines in this, its 28th consecutive showing at the national motor boat shows. Its range of sizes continues from $\frac{1}{2}$ to 33.4 hp., with a wide choice of weights and designs. The company's Elto line features an improved version of the $8\frac{1}{2}$ -lb. Cub, rated about $\frac{1}{2}$ hp., said to be the lightest outboard engine built.

Arnolt Motor Co., Warsaw, Ind., has redesigned a four-cylinder unit of 61 cu. in. displacement, developing 20 hp. Advantage has been taken of steel and aluminum alloys to bring the weight of this engine down to 200 lb.

A feature of the Kiekhaefer Corp.'s Mercury outboard engines is the Magnapull starter, which employs magnetic action for quick engagement and disengagement upon pulling the starter rope. This device was designed to safeguard the starting mechanism against damage and abnormal wear, especially in the event of backfiring when the motor is being stopped. The four engines of this Cedarburg, Wis., company are rated from 2.9 to 6 hp. Single-cylinder models have 5.5 cu. in. and two-cylinder models 11 cu. in. displacement. The gasoline tank is cast of aluminum alloy in two sections which are firmly joined together with a metal bond in a patented "vulcanizing" process.

Horace E. Dodge Boat and Plane Corporation showed a 16-cylinder V-type marine engine designed on aircraft-engine lines. It has a bore of $3\frac{11}{16}$ in. and a stroke of $4\frac{1}{4}$ in., making the displacement 726 cu. in., and it is rated 1000 hp. at 5000 r.p.m. Cylinders are cast of semi-steel, in blocks of four. There are master connecting rods in one bank and link rods in the other, the so-called articulated design being used. The crankshaft is supported in nine silver-cadmium bearings. Ray Day pistons are used. The engine has four overhead camshafts, and the valves make an angle with the cylinder axes. A centrifugal supercharger is fitted and supplies air to a Holley diaphragm-type carburetor. The supercharger is driven from the crankshaft in the ratio of 8:1 and it charges the engine at 15 lb. pressure. Its impeller is machined from a solid block of forgeable aluminum. There are two inlet manifolds, one for each bank of cylinders, and each is provided with a backfire valve. The engine has two water pumps and two magnetos. In addition to the exhaust manifold, the inlet manifold is water-jacketed (to take out some of the heat generated in the blower). The weight of the engine dry, without reversing and reduction gear, was given as 1470 lb. This engine is not yet in production.

The Crosley Marine, a newcomer in the marine-engine field, is a modification of the air-cooled Crosley small-car engine. Its two cylinders are opposed,

and it is rated from 8 to 10 hp. at 3000 r.p.m., its maximum recommended top speed. The engine, manufactured by Waukesha Motor Co., has a bore of 3 in. and a stroke of $2\frac{1}{2}$ in., giving the unit a displacement of 35.3 cu. in. It operates with a compression ratio of 5 to 1. It is equipped with a Tillotson carburetor, AC gasoline pump, and Electric Autolite electrical and ignition equipment. It weighs about 180 lb. The company, a partnership consisting of Powel Crosley, Jr., and his son, Powel Crosley, III, is also producing a family fishing boat and runabout of molded Weldwood at Miami, Fla.

One hundred and thirty-one motor

boats, sailboats, rowboats and canoes were on exhibition, the largest being a Chris-Craft 44, and Elco 57-ft. de luxe cabin cruisers. Boat designers, in planning the new models, have incorporated "torpedo boat lines" in hulls, keeping in mind possible conversion of the boats for auxiliary Navy and coast guard patrol duty in case of national emergency. Several of the manufacturers have heavy backlogs of orders on hand because of the government priority for auxiliary light craft.

The exhibitors at the show, including scores of manufacturers of marine hardware, and sail boat and motor boat accessories, represent 17 states.

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BRANCH OFFICES IN ALL PRINCIPAL CITIES



Nash Realines Facilities for '41 Models

(Continued from page 115)

hardened bushings, are raised and lowered manually over the pilot diameters on each end to assure alignment. Work is positioned for height and securely locked in place against the pins by manual movement of the rotary clamp-lock. The hydraulic unit advances the

driving bar through the part and engages the cutter head.

Tolerance on the diameter is plus or minus 0.002 in.; length of cut is $\frac{7}{8}$ in., with feed of 0.005 in. per revolution.

The axle driveshaft has some noteworthy features in its tooling, particu-

larly the fact that turning operations on the Fay automatic lathe are done with single point tools, Carboly-tipped for the principal turning operations. Another departure from the conventional is the grinding of the taper end on a Cincinnati centerless grinder. Splines are hobbled on a 6-spindle Lees-Bradner hobber; the end is threaded on a Landis threading machine.

Seaman Body

Before going into the description of the final assembly building, it is desirable to digress for a moment and shift the scene to Milwaukee where the Nash bodies are built.

Note first that the body shell stampings for all three lines—the Ambassador 600, the Ambassador Six and Ambassador Eight—are very similar. Principal difference is that the "Unitized" body for the low-priced car has a special underbody which incorporates pressed side channels. When the body side panels are welded to the underbody, the sides cover the open channels, producing, in effect, a box section side frame possessing unusual strength and rigidity.

Distinctive feature of body assembly at Seaman is the introduction of an oval-shaped merry-go-round assembly on which the bodies are framed and welded. There are two of these oval lines on the fifth floor, one for the low priced car, the other for the two large cars.

Underbodies come in from the first floor where they are prepared by welding special brackets and attachment elements, spray-painted in the open channel sections. They come in on a bar elevator conveyor on one side of the line and when set on the assembly conveyor constitute the backbone of the body structure. The other major stampings—the one-piece top, side, back panel, etc.—come in on an overhead conveyor line on the other side of the line.

Assembly work is done on framing fixtures, welding with portable Progressive gun welders and Lincoln Electric arc welders. Some of the major welding operations are shown pictorially, one of the most interesting being the use of huge U-form Progressive gun welding units mounted on an overhead trolley to facilitate reaching usually inaccessible places on the wheel house.

Each of the oval assembly lines has 16 stations. One of the major stations is that of making the roof assembly which is handled with a big framing jig suspended overhead. To assure precise alignment for this operation, the roof fixture is arranged to interlock with the lower framing fixture. The roof is fixed in place by arc welding.

After the shell structure has been welded up on the assembly line, it is lifted off by overhead hoist and transported to the metal finishing department.

For arc-welding operations both on the assembly line and in the metal finishing department, power is supplied from a battery of 17 Lincoln Electric

PICTURE of a MAN with WIREFORM PROBLEMS



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ACCURATE SPRING MANUFACTURING CO.
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150-amp. machines mounted on the fourth floor.

Outstanding is the arrangement for handling bodies through the paint. Nash bodies are finished in a synthetic paint, are handled on a single conveyor line 3600 ft. in length through all of the operations beginning with the 200-ft. Bonderite spray booth. The continuous overhead conveyor carries the bodies through the Bonderite spray, the Bonderite oven, prime spray booths, prime oven, prime wet sanding deck 300 ft. in length, and the dry-off oven after wet sand.

This conveyor system is automatically controlled by a Mechanical Handling Systems unit comprising two variable speed D.C. drives with fluid couplings. The drive is designed particularly for long conveyors, where it is necessary to divide the chain pull by the use of more than one drive. Without the use of this type of drive, long conveyors would not be possible, without greatly increasing the chain strength, the track size, and the size and capacity of the trolleys, which naturally would result in a considerable increase in the cost of the equipment.

Each of the two drive units consists of a D.C. motor connected by means of a hydraulic device to a speed reducer, which drives the conveyor chain either through a sprocket or a caterpillar drive attachment. Both of the motors for the two drives are wired through a voltage control device which permits the regulation of the speed of the conveyor by increasing or decreasing the voltage. A governor type switch is provided for both drives so that if the r.p.m. of either drive drops below a predetermined value, both drives will be shut down. This is to avoid the possibility of one drive taking all the load in the event that electrical or other troubles prevent the other drive from functioning.

One of the big difficulties previously encountered in the use of multiple drives has been the inability to regulate the chain tension. The hydraulic device can be regulated to take a predetermined amount of the chain load, and by making one drive lead, that is, adjusting it so that it will pull more load than the other drive, the position of the slack can be controlled.

This also prevents pulsation, which occurs in older drives and which, at times, becomes so pronounced that one portion of the conveyor will stand still, while other portions are moving. The hydraulic device prevents this; also makes possible a smooth and uniform acceleration of the conveyor on starting.

The remaining portions of the paint shop are devoted to final finishing operations—spray painting on the fourth floor, drying on the fifth. Two-tone finish is a special operation which is performed after the body has been through the standard paint procedure. Specials then are taken off the regular line, shifted to the two-tone department, where the bodies are suitably

masked. Then they are transported through a bank of Binks spray booths, dried in a huge Dry-Sys oven.

After proceeding through the paint shop operations, the finish-painted bodies reach a main transfer point where they are shifted, according to schedule, onto one of two trim lines.

Final Assembly

Major part of the transformation at Kenosha took place in the final assembly building to accommodate the novel line-up required for the new car. Saving grace in the situation was the fact that Nash had a five-story building directly adjacent to the final assembly

building, making it possible to move a variety of operations into the five-story structure.

This building now accommodates all of the sheet metal finish, sheet metal paint and storage, manufacture of gas tanks, etc. In addition, practically an entire floor has been set apart for the wheel and tire department, for tire storage, for wheel paint, for wheel and tire assembly. A novelty in the wheel department is the automatic arrangement for spray painting in which a merry-go-round table conveyor circles the spray booth, carries wheels on rotatable spindles. As the wheel enters the booth, it is engaged by two spray



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nozzles, one for the top, the other for the bottom, following the wheel right to the exit.

The device is fully automatic, handles 500 wheels per hour with only two operators—one for loading the conveyor, the other for transferring painted wheels to the drying oven conveyor.

The final assembly line for the new car embodies the fundamental changes in practice induced by the unit type body-frame structure. Since there is no separate chassis frame, final assembly begins with the simple operation of placing front end assemblies and rear axle unit assemblies directly on the

chassis conveyor in their proper location with respect to the wheelbase of the car. These units are laid loosely into fixtures. Next comes the power plant assembly. This is set loosely on the front end unit but bolted to the front end of the torque tube.

Next comes the attachment of rear wheels. The wheel assemblies are fed to the line on a gravity roller conveyor section mounted on the floor under the assembly conveyor so as to be convenient to operators on both sides of the line. This is followed by the body drop, bodies coming in from a parallel conveyor line.

From this point on, the bulk of as-

sembly operations, particularly front end fastenings, are handled from pits under the line. And to facilitate such operations, the conveyor is made extremely narrow. Front end sheet metal is assembled as a unit on a sub-assembly merry-go-round conveyor, then carried over to the final line for installation.

According to calculations made by the plant engineering department, the operations on the final assembly line take about 12.5 ft. of conveyor per car. This is said to be the most intensive utilization of space known in the industry. Another unusual fact is that Nash has found it possible to store a bank of 500 finished bodies on moving conveyor lines in the final assembly building.

We mentioned earlier the use of fluorescent lighting in the motor plant. The same type of light sources have been employed in lighting the body pits in the final assembly department.

Miscellaneous

In closing this study, we thought it of interest to make some comment on the use of special cutting materials on the various metal cutting operations. A few examples will suffice to indicate the degree to which such materials are employed. On the rear axle housing, which is a malleable iron casting, Ingersoll milling cutters with inserted blades of Haynes-Stellite J-Metal are used for the milling operation. Boring and facing on a Baker machine is done with Carboloy-tipped tools. The Greenlee boring machine for boring the tube holes also uses cemented-tungsten-carbide tipped tools.

On the rear axle shaft, the Fay automatic is equipped with Carboloy-tipped turning tools. On the differential case, made of malleable iron, the Fay automatics and the Ex-Cell-O facing machine both use Carboloy-tipped tools. The oil pump body, which features an unusual Greenlee one-way, 12-station machine, uses Carboloy-tipped drills, boring and facing tools and reamers.

Initial milling operations on the cylinder block on an Ingersoll milling machine are handled with Ray-blade cutters with inserted teeth of Haynes-Stellite J-Metal. Broaching the top and bottom faces of the block on the Cincinnati surface broaching machine, employs Carboloy-tipped broach sections in the finishing section of certain of the broaches. Ingersoll milling operations on the ends employ milling cutters with J-Metal inserts while milling of the sides is done with cemented-tungsten-carbide tipped tools. The Foote-Burt boring machine used for rough-boring cylinder bores, has Goddard & Goddard Carboloy-tipped cutters.

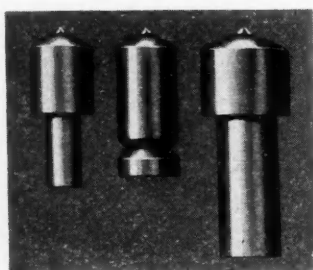
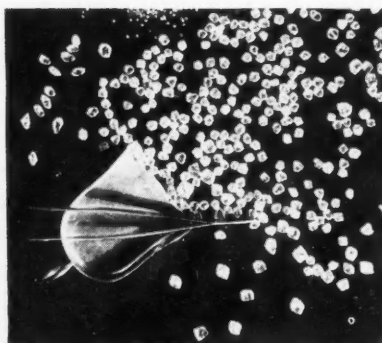
This list could be continued almost indefinitely to cover every major operation, but suffice it to say, in the interest of space economy, that Nash has taken advantage of most modern tool practice to facilitate productivity, improve quality, and to lower manufacturing costs.

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Left to Right—Landis Nib, Norton Nib, Cincinnati Nib.

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